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JANUARY

THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION

Ultraviolet Radiation—*Rasmussen*
General Anesthesia in Exodontia—*McKesson*
Porcelain Jacket Crowns—*Oppice*
What Is Research—*Hatton and Benedict*
Society of Denture Prosthetists—*Owen*
The Pulpless Tooth—*Buckley*
Gold and Its Alloys—*Wilkes*
Tooth Development—*Skillen and Mueller*
Newer Antiseptics—*Silverman*
Roentgen Ray—*Hume*
Dental Survey—*Cramer*
Regeneration of the Gingivae—*Lundquist*

EDITORIAL DEPARTMENT

The New Year
The Reputation of the Dental Profession

BUREAU OF CHEMISTRY

Atomidine

DENTAL HEALTH EDUCATION

Radio Talks

THIRTY-FIVE CENTS

CONTENTS

Harry Bear, D.D.S. ..... Frontispiece

ORIGINAL COMMUNICATIONS

Ultraviolet Radiation in the Treatment of Periodontal Diseases.
By A. T. Rasmussen, D.D.S. 3

The Influence of Certain Diseases on Technic and Other Considerations of General Anesthesia in Exodontia.
By E. J. McKesson, M.D. 18

Porcelain Jacket Crowns.
By Harold W. Oppice, D.D.S. 27

What is Research: Research in Fields Not Dental.
By Edward H. Hatton, B.L., M.D., and H. C. Benedict, M.S. 38

The Work of the National Society of Denture Prosthetists and Its Relation to the American Dental Association.
By Elbert Britten Owen, D.D.S. 39

The Pulpless Tooth, Its Pathology and Conservation; A New Method and Technic of Filling Root Canals.
By J. P. Buckley, Ph.G., D.D.S., F.A.C.D. 44

The Treatment and Filling of Vital Deciduous Teeth.
By John E. Gurley, D.D.S., F.A.C.D. 61

Some Clinical Manifestations of Oral Foci of Infection.
By C. E. Ervin, M.D. 68

Silicates.
E. J. C. Smith, D.D.S. 79

Determining Temperature of Gold and Its Alloys at Time of Casting.
By Alfred L. Wilkes, D.D.S. 85

Prognosis and Treatment of Pulpless Deciduous Teeth.
By W. R. Alvord, D.D.S. 93

Findings in Studies of Tooth Development.
By W. G. Skillen, D.D.S., and Emil Mueller, D.D.S., M.S. 98

Individual Mouth Records.
By Elmer W. Bunce, D.D.S. 108

The Use of Some of the Newer Antiseptics in Diffuse Oral Infections: Indications and Contraindications.
By S. L. Silverman, D.D.S., F.A.C.D. 115

The Roentgen Ray as an Aid in Examinations.
By E. C. Hume, D.D.S., F.A.C.D. 118

Dental Survey of One Thousand Adult Males: A Statistical Study Correlated with Physical and Laboratory Findings.
By H. C. Cramer, D.D.S. 122

Regeneration of the Gingivae Following Surgical Treatment of Pyorrhea with Special Reference to the Epithelium.
By G. R. Lundquist, D.D.S. 128

Monson Technic for Full Denture Construction.
By R. G. Keyworth, D.D.S. 130

EDITORIAL DEPARTMENT

The New Year.—The Reputation of the Dental Profession.—The Third Latin American Dental Congress 163-167

BUREAU OF CHEMISTRY

Atomidine 168

BUREAU OF DENTAL HEALTH EDUCATION

Dentistry of Yesterday and Today.
By C. N. Johnson 172

The Prevention of Decay of the Teeth.
By Russell W. Bunting, D.D.S. 174

Mouth Hygiene in Mississippi.
By Gladys Eyrich 176

Watch the Child's Teeth.
By Donald MacKay Gallie, D.D.S. 178

How to Preserve Your Teeth.
P. G. Puterbaugh, D.D.S. 180

What the Patient Should Know About Pyorrhea Treatment.
By Robin Adair, B.S., M.D., D.D.S. 182

The Tooth Question.
By George H. Wandel, D.D.S. 184

CURRENT LITERATURE

Extracts and Abstracts 186

MISCELLANY

Book Reviews 191

News 191

Announcements 193

ADVERTISING

Index to Advertisements A-50

Classified Section A-52, A-53

The Journal of the American Dental Association, Vol. XVI, No. 1. Published by the American Dental Association, 58 East Washington Street, Chicago, Ill. Yearly subscription, $2.50. Entered as second-class matter, May 1, 1928, at the post office at Chicago, Ill., under the act of Aug. 24, 1912. Published monthly.

THE JOURNAL

OF THE

American Dental Association

Study—Publish—Record

VOLUME XVI—1929

Owned and Published by the
American Dental Association
Chicago, Illinois

HARRY BEAR, D. D. S., Richmond, Va.
Vice President of the American Dental Association

THE JOURNAL
of the AMERICAN DENTAL ASSOCIATION

Vol. 16 JANUARY, 1929 No. 1

Original Communications

ULTRAVIOLET RADIATION IN THE TREATMENT OF PERIODONTAL DISEASES*

By A. T. RASMUSSEN, D.D.S., La Crosse, Wis.

SUNLIGHT is one of the oldest, if not in fact the oldest, remedy used in the healing art. Animals instinctively recognize the value of it, and the ancients of the human race knew somewhat of the effects of sunlight on the individual who was sick. History speaks of the means used by ancient peoples for exposing the body to direct sunshine. Hippocrates, 400 B. C., prescribed the sunbath. If memory serves me correctly, it was Pliny, who in the first century of the Christian Era, made the statement "Sol maximum remedium est" (the sun is the greatest remedy).

While the empiricism with which those early writers used and advocated the use of sunlight, without a knowledge of the nature of the remedy they were applying, was entirely excusable, there is no valid excuse in this day and age for the empiric methods too often employed in the use of radiant energy as a means for treating the sick.

It is with that thought in mind that I present this paper, to the end that we may have a more intelligent use of that part of the electromagnetic spectrum known as the ultraviolet by those of us who already are using it; as well as in an effort to stimulate intensive study of the subject by those who will adopt this means of treatment in the future.

It is my purpose to afford a speaking acquaintance, if you please, with the subject of radiant energy, codifying some of the scattered information which is available, and adding a few original observations and thoughts on the use of the ultraviolet zone of the spectrum, with the hope that others will take up the suggestions that I make, and by careful observation, prove or disprove the correctness of my conclusions.

*Read before the Section on Orthodontia and Periodontia, at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., August 23, 1928.

I have no desire to be the author of a method, or technic, of using ultraviolet rays or any other modality, means or drug, by "rule of thumb." Anyone desiring such will be disappointed in what I have to say.

Before proceeding further, let it be clearly understood that the biologic principles and laws that govern are the same no matter what part of the body is under consideration. All cellular structures are subject to the same pathologic changes. The pathology of inflammation is the same whether the structure attacked is the periodontal tissues or the peritoneum; the appendix or the great toe.

The same is true in the field of therapeutics. A drug or physical modality that will affect the cellular structures of the supporting tissues of the teeth in a given way will, in exactly the same way, affect similar cells though they be most remote from the teeth.

Bear in mind, therefore, that, in considering the use of ultraviolet rays in the treatment of any disease, it is the biophysical, or biochemical, effect of these rays that we are studying; first, that on the cells exposed to direct irradiation, and secondly, the effect on all the cellular structures of the body.

Radiant energy is any force or power which radiates from a given source. In speaking of heat, light, ultraviolet rays, roentgen rays, radium rays, etc., it is well to keep clearly in mind that all are a form of radiant energy. Each is a part of the electromagnetic spectrum, the various zones of which are readily demonstrated by the physicist. All radiant energy is in the form of waves caused by some electromagnetic disturbance of the hypothetic ether.

The only difference between the various forms of radiant energy just mentioned, as well as others, is in wave length and frequency. Wave length means the distance from the crest of one wave to the crest of the next, as in the case of water waves resulting from a disturbance of its surface. (Fig. 1.) Frequency means the number of impulses or disturbances per second, each of which sends forth one electromagnetic wave.

TABLE 1.—UNITS OF MEASUREMENT USED IN RECKONING ELECTROMAGNETIC WAVE LENGTHS

Units	Symbol	Millimeters	Relative Length
Angstrom	A°	One ten-millionth	1
Millimicron	$\mu\mu$	One millionth	10
Micron	μ	One thousandth	10,000
Millimeter	mm	One	10,000,000
Meter	m	One thousand	10,000,000,000

The units of measurement for reckoning the length of the waves of the spectrum having a wave length of less than 1 mm. are the micron (μ), one thousandth millimeter; the millimicron ($\mu\mu$), one millionth millimeter; and the Angstrom unit (A°), one ten-millionth millimeter. (Table 1.)

THE ELECTROMAGNETIC SPECTRUM

Before the therapeutic effects of radiant energy can be intelligently made use of, and the best results obtained, it is necessary to have at least a good working knowledge of the relation between frequency and wave length and especially between wave length and effect.

Bear in mind, therefore, that there exists a definite relation between wave length and frequency. The shorter the wave length, the higher the frequency. This is necessarily so, since all electromagnetic waves are propagated through space at the same velocity, of approximately 300,000 kilometers per second (186,300 miles). Thus, it will be seen that the frequency (F) of any given wave length is found by dividing the velocity of light (V) in millimeters by the wave length (W. L.) in millimeters. ($F = \frac{V}{W.L.}$). In the case of visible light rays with a wave length of from 8,000 to 4,000 A,° this formula will show that such waves radiate at a frequency of three hundred and seventy-five trillion to seven hundred and fifty trillion (375,000,000,000,000 to 750,000,000,000,000).

By the same formula, we find that the long ultraviolet rays have a frequency of seven hundred and fifty trillion (750,000,000,000,000), while the short ultraviolet rays of 1,800 A° have a frequency of more than one quadrillion, six hundred trillion (1,600,000,000,000,000) per second. (Table 2.)

The longest rays of the visible spectrum are the red; the shortest, the violet.

TABLE 2.—WAVE LENGTH AND FREQUENCY OF DIFFERENT SECTIONS OF THE ELECTROMAGNETIC SPECTRUM

	Wave Length in A°	Vibrations per Second (Frequency)
Waves of wireless telegraphy	Greater than 100 meters	Less than 3×10^{6}
Shortest electric waves	1 meter-1 mm.	3×10^{8}-3×10^{11}
Infrared Hg vapor emission	0.3 mm. or 3,000,000 A°	1×10^{12}
"Rest" region	1,500,000-200,000	0.002×10^{15}-0.015×10^{15}
Short wave infrared	200,000-8,000	0.015×10^{15}-0.375×10^{15}
Visible light	8,000-4,000	0.375×10^{15}-0.75×10^{15}
Ultraviolet	4,000-1,800	0.75×10^{15}-1.67×10^{15}
Shumann region	1,800-1,200	1.67×10^{15}-2.5×10^{15}
Lymann-Millikan region	1,200-150	2.5×10^{15}-20×10^{15}
Long wave roentgen ray	150-20	20×10^{15}-150×10^{15}
Roentgen rays	20-0.1	150×10^{15}-$30{,}000\times10^{15}$
Gamma rays	Less than 0.1	Greater than $30{,}000\times10^{15}$

From "Matter, Electricity, Energy" by Gerlach, and Fuchs.
Modified from "The Electromagnetic Spectrum" by the Council on Physical Therapy, A.M.A., 1928.

On either side of the visible spectrum are invisible rays. Those of longer wave length and at the left of the red are the so-called infrared, or heat rays. Those of shorter wave length and at the right of the violet are the ultraviolet rays.

It will be seen that the ultraviolet zone of the spectrum is a very small portion of the whole, having wave lengths ranging from 4,000 to 1,800 A.°

In studying the electromagnetic spectrum, one is struck by the frequency-wave-length-effect relationship that exists. I have already referred to the relation of frequency and wave length. It should be noted that as we descend the scale of wave length, there is a marked rise in the actinic properties of

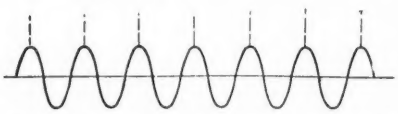


Fig. 1.—Graphic illustration of wave length.

the rays. Radium rays, the shortest rays known, are the most highly actinic.

According to the U. S. Bureau of Standards,[1] ordinary glass is opaque to ultraviolet rays below 3,100 A° in wave length. (Fig. 2.) Since the biologically active rays are all of a wave length below 3,200 A,° it is evident that no glass must intervene between the source of the rays and the part to be treated; also, that a glass mirror will not reflect the highly actinic rays of the shorter wave lengths since they will be absorbed by the glass.

1. The Ultraviolet Transmission of Various New Glasses and Window Glass Substitutes as Compared with That of Common Window Glass, Letter Circular 235, U. S. Department of Commerce, Bureau of Standards, Jan. 14, 1928.

SOURCES OF ULTRAVIOLET RAYS

There are three main sources of ultraviolet rays: the sun, the carbon arc and the quartz-mercury arc.

The available ultraviolet rays of sunlight have been variously estimated, but probably are not more than 7 per cent. Atmospheric conditions interfere greatly with the passage of these rays to the earth, so that under certain conditions the amount that reaches the earth is practically nil. A clear, dust-free atmosphere and high altitudes favor the passage of these rays from the sun.

The carbon arc is more constant than sunlight, and about as efficient, but has certain drawbacks, which need not be considered here.

The quartz-mercury arc is the most efficient of all sources, giving as high as 28 per cent of ultraviolet rays. There are two types of these generators, the air-cooled, and the water-cooled. (Fig. 3.) It is claimed by many that the air-cooled generator (or lamp) emits a greater percentage of the longer rays than does the water-cooled generator. Clinical experience has led me to believe that this depends largely on the temperature at which the water-cooled generator is operated. If a low operating temperature is employed, there will probably be a higher percentage of the short-wave rays emitted, while as the operating temperature rises, a corresponding increase in the percentage of longer wave lengths will be noted by the effect on the skin, everything else being equal. I shall have more to say about this later.

Prof. Niels Finsen, of Copenhagen, was the first to practice heliotherapy, using artificially generated rays. In 1893, he published the results of his work in treating tuberculosis with rays generated by a carbon arc lamp. This

type of generator became known as the Finsen light.

All incandescent metals emit some ultraviolet rays, as well as the visible and infrared rays; but it must be remembered that when inclosed in glass, all of the biologically active ultraviolet rays are absorbed by the glass.

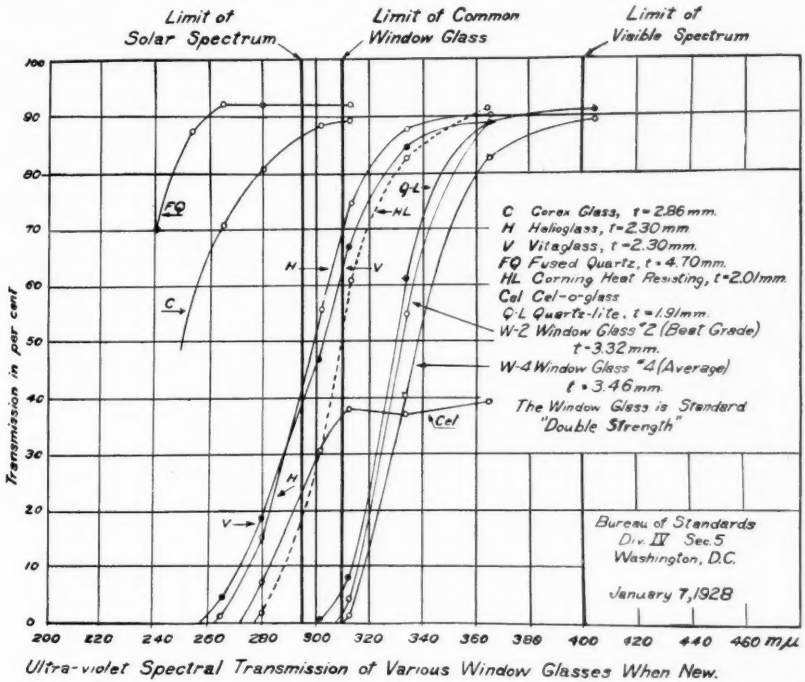


Fig. 2.—Ultraviolet spectral transmission of various types of window glass when new.

BIOLOGIC EFFECTS OF ULTRAVIOLET RAYS

The biologic effects of light rays, or, more properly speaking, radiant energy, on living tissues is not confined to the visible rays. Both the infrared rays and the ultraviolet have very definite effects when vital structures are subjected to their influence. As an example of this may be mentioned the quick sprouting and extremely rapid unorganized growth of potatoes and other vegetables and plants when kept in a warm, dark place, in contrast to the slower, well organized normal growth of the same plants when subjected to the visible and ultraviolet rays of the solar spectrum. According to the Council on Physical Therapy of the American Medical Association,[2] Bovie and others have demonstrated and measured the retarding effect of ultraviolet light on the growth of plants and also

2. Significance of Wave Length in the Biologic and Physical Action of Radiant Energy, Council on Physical Therapy, A. M. A., 1928.

the growth-promoting effect of the heat rays.

In this communication, we are concerned, primarily, with that zone of the electromagnetic spectrum, commonly called the ultraviolet, in which the wave lengths range from approximately 4,000 A° (Angstrom units) to about 1,800 A.° Within this narrow zone lie what has been so aptly called, the "life rays" of the spectrum.

Ultraviolet rays activate the metabolic processes of the animal organisms to

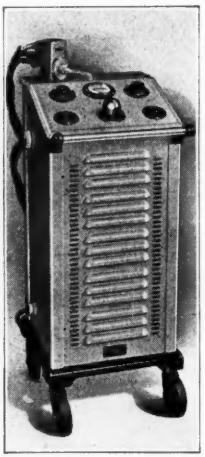


Fig. 3.—Ultraviolet ray generator cabinet containing electric transformers, water circulating equipment, control instruments and water-cooled generator. The same cabinet is used for the air-cooled generator.

normalcy. Disturbed mineral metabolism in the animal is corrected by ultraviolet irradiation. The absorption of such mineral elements as calcium, phosphorus, iron and iodin is markedly increased in cases of rickets and other deficiency diseases. Since the calcium and other minerals of the blood govern so largely the general health of the individual, it behooves us to take seriously any means at our disposal to fix and stabilize these minerals in the cells and body fluids.

Vitamin D has been credited very generally with being antirachitic in effect, owing to its calcium and phosphorus fixing powers. Certain it is that what we have called vitamin D effects a cure in the calcium and phosphorus deficiency diseases.

It has been supposed that vitamin D was a definite something having the power to control mineral metabolism of the body. According to Granger,[3] vitamin D is produced by the action of the ultraviolet rays on the cholesterol of the skin.

In speaking of the effects of vitamins, Barlow [4] says, "Vitamin D has to do with calcium deposit and growth of bone and hair. It is found most abundant in cod-liver oil and sunshine."

In a recent address at the college dinner of the American College of Physical Therapy, Barlow,[5] in reporting animal experiments, said "Vitamin D is a definite calcium depositing agent. Ultraviolet rays are rich in vitamin D, and some vitamin A."

Bloch and Faber[6] also found that these rays have a profound effect on mineral metabolism. They say that "light, and particularly ultraviolet rays,

3. Granger, F. B.: The Ultraviolet: Its Sources, Uses and Dangers, J. A. M. A., to be published.

4. Barlow, R. A.: Does Vitamin-Deficient Diet Cause Deafness? Laryngoscope, 37:640 (Sept.) 1927.

5. Barlow, R. A.: Effects of Vitamin-Deficient Diet and Ultra Violet Irradiations on the Respiratory Mucosa and Special Senses, College Dinner Address, Minneapolis, Minn., June 11, 1928.

6. Bloch, C. E., and Faber, Frans: Light and the Anti-Rachitic Factor, Am. J. Dis. Child., 30:504 (Oct.) 1925.

have a stimulating effect on the organism, which chiefly benefits those functions that are depressed." These authors believe that it is a direct biochemical, or, shall I say, biophysical effect, and not the formation of a vitamin which in turn stimulates the depressed functions; for, in concluding their report on the antirachitic factor of light, they say that "evidently the hypothetic antirachitic vitamin does not exist."

It would appear, in the light of present-day knowledge that the vitamins or at least vitamin D is either stored up radiant energy or the direct result of such energy.

Be that as it may, there is no questioning that ultraviolet rays are the important factor in restoring the normal balance in the so-called deficiency diseases.

Referring to animals in extreme stages of rickets as the result of a calcium-deficient diet, Barlow[4] observes that "if the animal is exposed to ultraviolet light ...it will in a few days show improvement."

Davis[7] likewise found that the calcium content of the blood was increased in most of his experiments. He further records that the coagulation time of the blood is decreased in those exposed to the ultraviolet rays. This, he says, "is undoubtedly due to an increase in the calcium content."

According to Tisdall's[8] experiments, the ionic calcium content of the blood was raised to normal in rachitic infants, and the patients cured as the result of ultraviolet irradiation.

Exposure of ultraviolet rays has a beneficial effect in restoring the normal alkali balance in cases of acidosis. May I pause here to say that I find in patients suffering from periodontal diseases that a physiologic urinalysis will almost always show an abnormally high acid content.

Donnelly[9] writes that "biologic ultraviolet energy tends to overcome acid-

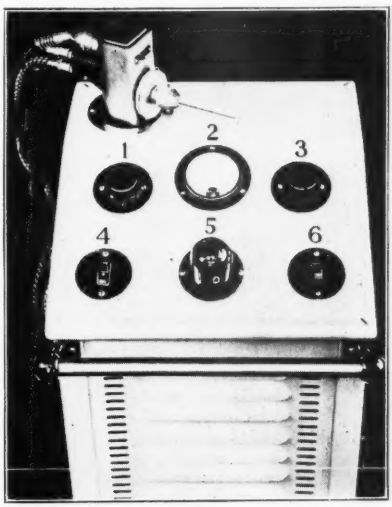


Fig. 4.—Control board. *1*, selective switch; *2*, volt meter; *3*, voltage regulator; *4*, main switch; *5*, water-flow indicator; *6*, intensity switch. The water-cooled generator, with quartz applicator attached, rests in the control board.

osis," while Davis,[7] in a more conservative statement, says that "it would appear that ultraviolet ray treatment may be beneficial in certain cases of acidosis,

7. Davis, F. A.: Further Study in Blood Chemistry and the Results of Ultra Violet Ray Therapy in Certain Tuberculous and Other Cases, M. J. & Rec., 122:188 (Aug.) 1925.

8. Tisdall, F. F.: Effects of Ultra Violet Ray on Calcium and Inorganic Phosphate Content of the Blood Serum of Rachitic Infants, Canadian M. A. J., 12:536 (Aug.) 1922.

9. Donnelly, L. C.: Ultra Violet Energy in Surgery, Reprinted from Physical Therapy as Special Bulletin, No. 313, by Burdick Corp.

where the normal alkali base of the system is distributed on the negative side."

These rays are analgesic in their effect. This quality has frequently been made use of, and some most remarkable reports might be made. Many other writers have observed this to be the case. This is a very important property and should not be lost sight of.

Irradiation by ultraviolet rays causes the bactericidal powers of the blood to be increased. The rays stimulate the phagocytic action of the leukocytes, increasing the formation of antibodies, as

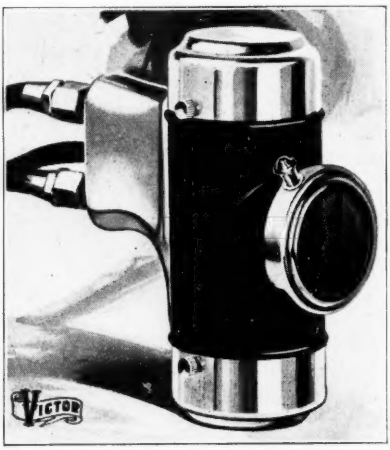


Fig. 5.—Water-cooled quartz mercury arc ultraviolet ray generator with fused quartz window for transmission of rays. The tubes for circulating water around the quartz mercury arc are shown.

well as the quantity and quality of the red blood cells.[10]

Warnshuis[11] quotes Professor Dorno, of Germany, in reporting results of his animal experiments, as saying that "in the superficial capillaries of the skin, the plasma of the blood has its oxygen increased, the number of red cells is also augmented, and their content of hemoglobin becomes richer. The urea of the blood is diminished. The blood stream thus constantly renewed, conveys these transformed, revitalized elements to the deeper organs."

That the shorter wave lengths of the ultraviolet zone are highly bactericidal has been well established. The United States Bureau of Standards has published some interesting information showing the power of these rays in destroying bacterial life.

Donnelly[9] is authority for the statement that "no germ has yet been discovered that will live longer than twenty-five seconds when brought in optical contact with ultraviolet energy." He does not make clear just what he means by "optical contact." There is much evidence to indicate that the intensity of the rays to a large measure determines the length of time such micro-organisms will survive. Most organisms will be destroyed on exposure for only a few seconds.

Taylor[12] finds, and reports, that "applied locally, the quartz-mercury arc . . . is a stimulant to cicatrization." This has frequently been observed clinically in the treatment of extensive burns and chronic indolent ulcers. Such lesions heal much more readily when irradiated with the ultraviolet rays.

While many writers have claimed that the shorter rays, generated largely by the water-cooled quartz-mercury arc, did not appreciably affect the calcium con-

10. Brooke, C. R.: Ultra Violet Rays in the Treatment of Some Nasal and Oral Conditions, M. J. & Rec. (Supp.), 122:681 (Dec. 2) 1925.

11. Warnshuis, G. J.: Life Ray of Modern Medicine, Clin. Med. (Reprinted as Special Bulletin, No. 303, by Burdick Corp.)

12. Taylor, H. L.: Treatment of Tuberculosis, Minnesota Med., 6:616 (Nov.) 1923.

tent of the blood and other cellular structures, Goodman and Anderson[13] say of rays shorter than 2,900 A° that "recent experimental work proves that these radiations are very effective in curing rickets, and in activating cholesterol, foodstuffs and oils."

That the ultraviolet rays are all absorbed by the outer layers of the skin, or other tissue, has been quite generally accepted as fact in the past. Macht, Anderson, and Bell[14] have recently shown that these rays actually penetrate much more deeply than was formerly supposed. They have also shown that some of the shorter rays penetrate more deeply than the longer ones.

Levine[15] aptly speaks of the ultraviolet rays as a normalizing power, the effects of which never go beyond the normal; i. e., the blood calcium content is never raised above the normal, even with prolonged and excessive irradiations. Neither are calcium deposits in the bony structures carried to excess. When normalcy is reached, the process ceases.

That no potent means of treatment is without its elements of danger is an accepted fact. So it is with ultraviolet rays. As with drugs, in the hands of the inexperienced, or the charlatan, this valuable modality may become a source of danger.

Davis[7] calls attention to the danger in overexposure as causing excessive pigmentation, thickening and scaling of the skin, with a resultant decrease in the hemoglobin of the red blood cells.

Overexposure to the ultraviolet rays causes, first, dilatation of blood vessels; then, slowing of the blood stream, and, finally, thrombosis, excessive hyperemia, desquamation and reduction of the bactericidal activity of the cells.[16]

Professor Dorno, as quoted by Warnshuis,[11] says that "animal experiments show that the ultraviolet rays from a mercury vapor lamp, when employed systematically and continuously, produce lesions, especially hemorrhagic infarcts in the spleen, liver, and lungs, which cause the death of the animal."

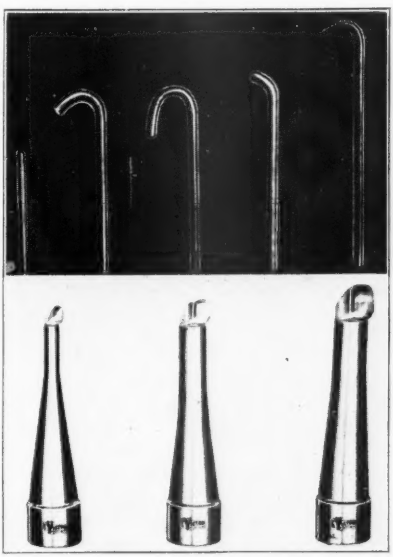


Fig. 6.—Quartz applicators for use with water-cooled ultraviolet ray generator. Above: Solid fused quartz rods. Below: Hollow tube applicators, with quartz tips.

13. Goodman, Herman, and Anderson, W. T., Jr.: Quantitative Study of Clinical Ultraviolet Sources, J. A. M. A., 90:671 (Mar. 3) 1928.

14. Macht, D. I., Anderson, W. T. Jr., and Bell, F. K.: The Penetration of Ultraviolet Rays into Live Animal Tissues, J. A. M. A., 90:161 (Jan. 21) 1928.

15. Levine, V. E.: College Dinner Address, Am. Coll. Physical Therapy, Minneapolis, Minn., June 11, 1928.

16. Brown, O. H.: Southwestern Med., 10:532 (Dec.) 1926.

APPLICATION TO MOUTH LESIONS

It needs no further argument, it would seem, to show that an agent which is so potent in reestablishing the normal functions of the tissues is a valuable aid in treating lesions of the oral cavity as well as other parts of the body. I might cite case reports from practice, or quote many authors on the results obtained, but I have chosen to use the time in considering the principles involved rather than to recite the results of my own treatments; for be it understood that no novice in this subject can expect to get the same results until he has given long and faithful thought to it and made careful clinical observations over a long period of time.

Luigi,[17] Dunn,[18] Folstein,[19] Holman,[20] Kieffer,[21] Lake,[22] Lyons,[23] Parsons,[24] Platts,[25] MacWhiney,[26] Springer and Tardieu,[27] Donnelly,[28] Rowlett[29] and many others have reported brilliant results from the use of ultraviolet rays in diseases of the mouth, especially periodontal lesions.

There is no question that ultraviolet rays, intelligently used, are one of the most valuable means we have for treating periodontal diseases; for, in practically all of these lesions, we find that the mineral metabolism is disturbed; the alkali balance is below normal, resulting in acidosis; the calcium content of the alveolar process is reduced, sometimes to the point of complete destruction of the bone, and the resistance of the tissues is lowered so that the defensive forces are unable to throw off the ever-present infection.

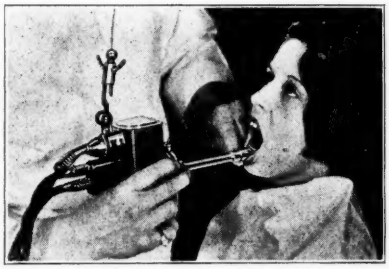


Fig. 7.—Method of applying ultraviolet rays to the gums with water-cooled quartz mercury arc through quartz applicator.

17. Arnone, Luigi: Ray Therapy Versus Surgical Methods, Dent. Cosmos, 67:255 (Mar.) 1925.

18. Dunn, William: Ultraviolet Rays, Dent. Mag., 45:3 (Jan.) 1928.

19. Folstein, I. L.: Quartz Light in the Treatment of Pyorrhea, Dent. Cosmos, 67:153 (Feb.) 1925. Treating Abscessed Teeth with Quartz Light, ibid. 67:1097 (Nov.) 1925.

20. Holman, C. B.: Ultraviolet Ray Therapy in Dentistry, Dent. Cosmos, 69:278 (March) 1927.

21. Kieffer, Joseph: Biological and Clinical Significance of Heliotherapy in Dentistry, Am. Dent. Surgeon, 46:807 (Dec.) 1926.

22. Lake, F. W.: Ultraviolet Rays in Dentistry, Hettinger's Dent. News, 11:9 (Jan.) 1928; Ultraviolet Radiation in Oral Lesions, Dent. Cosmos, 67:196 (Feb.) 1925.

23. Lyons, M. A.: Use of X-Ray as an Aid in Treatment of Pyorrhea, Am. Dent. Surgeon, 47:467 (Aug.) 1927.

24. Parsons, A. L.: Actino Therapy Applied in Dentistry, Dent. Cosmos, 67:612 (June) 1925.

25. Platts, A. L.: Value of Ultraviolet Radiations, Bull. Chicago Dent. Soc., 7:15 (Oct. 29) 1926.

26. MacWhinnie, A. B.: Pyorrhea; Treatment with Mercury Quartz Lamp, Pacific Dent. Gaz., 35:589 (Oct.) 1927.

27. Springer, M., and Tardiu, A.: Action of Ultraviolet Rays on Growth, Bull. Acad. de Med., Paris, 95:394 (April 20) 1926; Abstr. J. A. M. A., 86:1947 (June 19) 1926.

28. Donelly, L. C.: Ultraviolet Radiation in Dental Surgery. Am. Dent. Surgeon, 46:105 (Jan.) 1926.

29. Rowlett, A. E.: Ultraviolet Radiation in Dentistry, Am. Dent. Surgeon, 46:629 (Sept.) 1926.

All of these pathologic conditions the ultraviolet rays tend to correct. Therefore, used in conjunction with such surgical and other procedures as indicated in each case, they should materially assist in affecting a cure, and they do.

Careful clinical observation and experience for a number of years has convinced me of this. On the other hand, I am just as thoroughly convinced that there is danger of this agent becoming commercialized, just as other means have, with the result that the benefits will not be obtained, and possibly actual injury may result, in many cases.

Let me sound a warning that this is not a thing to be turned over to the nurse or office girl to use according to some set rules. Its scientific application requires as careful thought as anything we use. The dentist who is unwilling to apply himself to a careful study of the subject, and then give of his own time in making application of it, had better leave it to some one else.

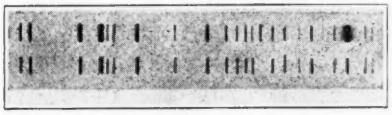


Fig. 8.—Above: Spectogram showing the water-cooled spectrum giving the great intensity of the 2536 line (heavy haloed line at right). Below: Spectrum of much less intensity obtained from the same lamp improperly operated at very high voltage.

Neither will this means of treatment relieve the operator of the arduous task of surgical curettement of diseased areas or pockets about the roots of teeth. It is not a panacea for these troubles. It is a valuable aid, producing desirable results in a way that nothing else does.

APPLICATION

There are two practical ways in which to apply the rays locally: (1) the open method, in which the rays pass through the air to the parts being treated, and (2) the quartz applicator method, in which the rays are transmitted through a quartz rod, one end of which is held by suitable means in front of the quartz window of the generator, the other end being applied to the parts under treatment. (Figs. 4-5.) Sometimes, a combination of these are used in which the rays pass through an open tube in the distal end of which is set a piece of fused quartz so shaped as to deliver the rays where desired. (Fig. 6.)

Quartz, having the power to refract, or bend, the rays, and absorbing a comparatively small amount, the solid quartz rod is the method of choice in most cases. These applicators can be secured, bent at different angles, to facilitate the application of the rays to parts inaccessible to a straight one. Owing to the fact that there is a considerable loss of the rays at a bend in the quartz rod, the loss depending on the angle of the bend, it is advisable to use a straight applicator whenever possible.

The method of irradiating the periodontal structures consists of having the parts reasonably free from saliva or blood. With a suitable applicator attached to the generator, the end of it is placed on the part to be treated, sufficient pressure being applied to dehematize the soft tissues, as evidenced by their blanched appearance. It is usually advisable to apply the applicator to the gums between the teeth, as well as over the apex of the root. The applicator must be kept free from contact with cheeks, tongue or saliva, to prevent loss of rays, which occurs on such contact. (Fig. 7.)

Both labiobuccal and lingual irradiation is advisable. Dehematization should always be accomplished by pressure rather than by means of drugs. Blood absorbs ultraviolet rays completely. Dehematization is done in order to get deeper penetration for the local effect, but the effect on the blood cells beyond the dehematized structures is an important one. Hence, epinephrin or similar agents which will effect the flow of blood in structures beyond those reached by the rays must not be used.

Irradiation should be carried to the point of a marked erythema. This may be repeated at such time as the erythema disappears. It will usually be found that a slightly larger dose can be given each time.

Many authors advocate treating only a small area at a time, viz., over two or three teeth. It has not been my experience that this is important. I usually treat not less than one quarter of the total area of both arches and do not hesitate to irradiate both the labiobuccal and the lingual sides of both arches at the same time, if the occasion demands. I have never had anything more serious occur than the discomfort of resultant vesication.

It should be noted here that no immediate effects are noticeable. With proper dosage, there appears a sense of tingling and slight swelling a few hours after irradiation. Vesicles may appear, but need give no alarm. I frequently carry the treatment to the stage of severe blistering in order to get a greater local reaction.

I know of no way to determine what dosage will be required to produce the desired effect on a given individual except to make a test. In my practice, I have found patients requiring five times the average exposure (with my equipment) in order to get the desired reaction, everything else being equal.

I have found it practical to gain some idea of a patient's resistance to the rays by giving several exposures of different dosage on parts of the body not exposed to the direct rays of the sun, noting the erythema resulting therefrom. Since the height of the erythema is not reached until the following day, it means one more call, but it is usually well worth the time.

DOSAGE

A perusal of the literature soon reveals the utter lack of any practical, scientific basis for measuring the dose of ultraviolet energy given. One is left entirely at sea by such statements as "the exposure ranges from one to two minutes the first day, increasing one minute each day," etc., or "the lamp should be allowed to burn for five minutes before beginning treatment." It is possible to find in the literature pertaining to the subject suggested dosages ranging from little or nothing to such time as would positively be dangerous in using a generator of high efficiency.

Rarely is anything said about the voltage used or the amperage consumed. In fact, there are many generators in use that are not equipped with meters for reading either voltage or amperage. Without such devices, the matter of dosage becomes mere guesswork.

Since the water-cooled quartz-mercury arc is the generator of choice in the local treatment of oral lesions, I shall confine myself to describing a definite method of gaging the dosage when using that type of generator for local treatment, although I am firmly convinced that general irradiation of the patient is of much value in treating many disturbances which exhibit themselves as mouth lesions. Such general treatment can, of

course, be given with the water-cooled generator, but not so conveniently as with the air-cooled.

Dosage cannot be intelligently expressed in units of time. The reason for this is that many variable factors enter into consideration.

1. No two generators, even of the same make, however much alike they may seem to be, will deliver the same amount of the various wave lengths, everything else being equal. I am informed by physicists that there may be a variable factor here of a considerable amount.

2. The efficiency of the quartz applicators in transmitting the ultraviolet rays varies to a marked extent. So many things influence the transmitting efficiency of applicators that are apparently the same that, like the generator, each has its own rating. The length and diameter of the applicator; the purity of the quartz; any imperfection or bubble, however small, or any bend in the applicator, greatly affects its transmitting power, and influences largely the amount of ultraviolet rays leaving the end.

Let me illustrate. I have three quartz applicators of apparently the same quality, the same length and diameter, and yet their relative efficiency is as 1:3 and 1:5. In other words, it takes five times the length of exposure with one of them that is required with the other to get the same effect, everything else being equal.

3. The generator voltage and amperage govern the intensity and wave length of the rays produced.

4. The operating temperature of the generator governs the amperage (current) consumed and, in turn, the wave length. Pacini[30] finds that "the effect of increasing temperature is to amplify the relative intensity of the shorter wave lengths."

That the rays from a water-cooled generator are more highly bactericidal and differ somewhat in their chemical action probably does not lie in the nature of the rays actually produced, but is due to the fact that the more efficient cooling system of the water-cooled generator condenses the volatile mercury vapor surrounding the incandescent arc, as described by Pacini,[30] thereby allowing "a maximum emission" of the shorter wave lengths. (Fig. 8.)

Since we know that all metals in the incandescent state emit some ultraviolet rays, it is reasonable to suppose that a lower state of incandescence of the mercury vapor will cause a lesser amount of the rays to be produced. The importance of voltage-amperage-temperature is therefore self-evident.

Thus, it will be seen that each combination of generator and applicator is a law unto itself. This, in addition to the variable factors of voltage-amperage-temperature, plus the difference in toleration of the patient, forbids describing dosage in mere terms of time and distance.

CALCULATING THE DOSE

With these variable factors in mind, a formula for calculating the dosage has been worked out and is expressed in volt-seconds. Thus, a ten second exposure, using 70 volts on the generator, will give a dose of 700 volt-seconds. In other words, the dose (D) equals burner voltage (B. V.) times seconds of exposure (S) (D. = B. V. $\times$ S.).

In view of the fact that each combination of generator-applicator has an efficiency constant all its own, it is necessary to establish a standard by which to be guided. To do this, select one ap-

30. Pacini, A. J.: Ultraviolet Radiation, J. Radiol., 3:378 (Sept.), 481 (Nov.) 1922; 4:80 (March) 1923.

plicator, preferably a straight one, and find the number of seconds it takes to produce an erythema of the skin of a definite degree, as evidenced by the redness which appears several hours after irradiation. A good place to try this is on the inside of your own forearm, provided it has not been exposed much to direct sunshine. Always use the same generator voltage in making these tests, and circulate the water through the generator at as nearly the same rate as possible. Having found the erythema dose for yourself, test it out on several other persons, always using the same voltage-temperature constant. When you have tested and kept a record of a goodly number of persons, you will be able to determine what constitutes an average volt-second erythema dose, with that particular combination of generator and applicator. Having found this, use it as the standard.

Now proceed to test your other applicators in order to establish the relative efficiency of each. Do this by giving the erythema dose with the "standard" applicator, making similar exposures with each of the other applicators, about an inch apart, and noting the erythema resulting from each. Keep making these tests until you arrive at a dose giving the same degree of erythema for all of them. You have then established the relative efficiency of your different applicators.

You will note that I am saying nothing of amperage. The reason for this is that the operating temperature automatically controls the amperage. As the operating temperature rises, the amperage falls, and vice versa,[30] thus "tending to constancy."

DOSAGE AND THE PATIENT

The difference in tolerance exhibited by individuals makes it imperative that care be exercised in using ultraviolet rays. Only experience will help the operator to judge the tolerance of each patient. It may be stated in general terms that brunets are more tolerant than blondes.

As a rule, it is safer to begin with a small dose and gradually work up than to give an overdose at the first treatment. Sometimes, it is of greater benefit to give a heavy dose, even to the point of severe vesication, the first time. This is a matter of good judgment on the part of the operator and must be determined in the light of what has been said before.

While not a cureall, radiant energy, in the form of ultraviolet rays, is a potent force to be used intelligently in our efforts to restore the sick to health.

211 Linker Building.

DISCUSSION

E. J. Weaver, Milwaukee, Wis.: I consider Dr. Rasmussen's paper the most thorough and exhaustive review of the present knowledge of ultraviolet that it has been my privilege to study. He has gone over about all the knowledge that has been accumulated in relation to the study of the spectrum, and his collection of data should be in the hands of anyone wishing a thorough understanding of the local application of artificial sun rays. As I am more interested in the clinical application of the water-cooled quartz light, I shall comment briefly on this form of radiation. Before doing so, I wish to compare the action of the carbon arc form of light radiation with the quartz light as a form of general stimulation. Dr. Rasmussen mentioned both forms of producing and applying the short rays. This knowledge I gained at Battle Creek, which was the first place in the country that I could find where the rays have been used extensively since the infancy of this treatment. They have found, after extensive experience, that, in subjecting the whole body to the action of these rays, those produced by the carbon arcs lamp seem to give the best results for

the following reasons: 1. The carbon arc produces more of the red and infrared rays. 2. The heat is greater. 3. The tanning is a more natural color, not so lemon colored as that produced by the mercury light; in fact, more like what is actually produced by the sun. 4. The carbon arc is less apt to produce serious burning owing to the warning given by the heat. Then, too, the light is more constant and less affected by any changes in amperage. I am giving this information as I obtained it for what it is worth. I am confident that it is the result of much research and clinical study. In the local application of the ultraviolet rays, Dr. Rasmussen has noted the general ideas of its application. After our experience of four years in the use of the water-cooled light, I would not wish to get along without this form of treatment as an adjunct in our work. Although some operators agree with Dr. Rasmussen as to applying the light such a time as to produce quite marked burning or marked erythema, it is our experience, after trying that method, that better results are obtained by carrying the treatment just to the point of burning, but stopping short of producing erythema. In regard to the tolerance of different patients, as Dr. Rasmussen has noted, we find the tolerance of brunets to be greater than blondes. We start with, say, half minute exposures, with a half inch applicator at between 80 and 90 amperes, then step it up as indicated. Our argument against carrying the treatment to beyond the burning stage is that the irritation and discomfort produced seems, in our minds, to outweigh the benefits, and a week might have to elapse before another treatment could be given. In the meantime, the analgesic effect, which we so much want, is lost. Our experience is that we get better regeneration in this manner than by producing pronounced erythema. I might hazard a guess that, outside the mouth, the reverse might be true. As to who in the office is to give these treatments, Dr. Rasmussen is of the opinion that no one but the dentist himself should operate the light. Perhaps from some angles, his point is well taken, but, sad to say, if the dentist was giving these treatments all day, he would not be able to do much else. A nurse or hygienist should be just as competent to give the light application as she is to do other treatment work or give prophylactic treatments. In our office, our nurse is more proficient in ultraviolet light treatments than I am, for the reason that her work is confined entirely to that and other forms of treatment. Any light must be carefully watched and serviced. The water flow, as Dr. Rasmussen has mentioned, is very important and although the improvement, in these lights, has been marked in the last couple of years, they lose their efficiency through continued or excessive service. With Dr. Rasmussen, I consider the ultraviolet light a valuable adjunct in the treatment of diseases of the mouth.

THE INFLUENCE OF CERTAIN DISEASES ON TECHNIC AND OTHER CONSIDERATIONS OF GENERAL ANESTHESIA IN EXODONTIA*

By E. I. McKESSON, M. D., Toledo, Ohio

IT is always a source of inspiration to contemplate the boon to mankind which many of your members have contributed and are contributing toward lengthening the span of human life and the relief of pain and discomfort. The work of Horace Wells carries with it everlasting honor to your profession and to America. It stands as an exemplification of brilliant observation, conviction and courage in the field of scientific discoveries. Following Wells, there have been a continuous stream of contributors to the science and art of anesthesia out of the ranks of the dental profession whose names are familiar to us all.

Although not a member, I feel a welcome, a comradeship with you through one of the common bonds which unite the medical and dental professions, anesthesia—a science of great interest and an art most intimately associated with life itself.

It is always desirable to know an essayist's background of experience in order to appreciate his point of view and to determine how much of his experience can be accredited and utilized. My connection with dental cases is entirely for anesthesia and is not operative. Our dental cases represent slightly more than one-third of all anesthesias administered. Roughly, one-third of these dental operations are performed on hospitalized patients who are either too ill to go to the dental office or are confined to the home. About one-third are private cases in office practice, while the other third are ambulatory free cases cared for in a dental dispensary. It will be seen that the number of seriously ill patients in our dental practice is relatively large.

There are sufficient differences in technic required for anesthesia in a seriously ill patient to warrant consideration of such cases as to both diagnosis of the physical condition present and preparation and management of the case.

PRIMARY ANEMIA

A considerable number of cases of severe anemia require the extraction of teeth.

In a case of anemia of such degree as to render an operation somewhat hazardous, the blanched appearance of the skin, with or without a yellowish, greenish or grayish tinge, is highly suggestive. Blood examination including hemoglobin index, cell count and coagulation time is required for proper management of the case. The patient may have received a blood transfusion, which is an aid in lessening the danger of secondary hemorrhage and also in rendering the anesthesia easier and safer.

*Read before the Section on Oral Surgery, Exodontia and Anesthesia at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 22, 1928.

Primary anemia of gradual onset and long duration renders the patient more susceptible to general anesthetics and increases the need for extraordinary care and a longer time of induction, probably because the body has more or less accommodated itself to an impoverished blood and the patient is weakened. Secondly, the anesthetic gas is carried more readily than is oxygen; and thirdly, a marked anoxemia may endanger the nervous system of such a patient. Anoxemia cannot be estimated by cyanosis, since cyanosis cannot be produced in such cases owing to the low hemoglobin content of the blood. Only muscular signs of anesthesia, such as the respiration, the general muscular condition, the eye, etc., can act as a guide as to the proper level of anesthesia to be maintained.

In a case reported some years ago, I was compelled to administer 60 per cent oxygen and 40 per cent nitrous oxid to avoid fourth stage or dangerous anesthesia. By far the greater part of this oxygen was used to reduce the nitrous oxid to a safe dosage as the hemoglobin was unable to carry even a normal load of oxygen.

These patients should be slowly anesthetized, the anesthetist beginning with high percentages of oxygen and low percentages of nitrous oxid, and either increasing or decreasing the percentage of oxygen in the mixture as subsequent muscular signs may indicate.

Patients having moderate primary anemia, that is those with more than 50 per cent hemoglobin in the blood, do well and respond normally to the ordinary technic of anesthetization.

SECONDARY ANEMIA

It is conceivable that an extraction may be required after a recent massive hemorrhage, such as that following automobile or other accidents. These are sometimes more difficult to handle safely if the patient is alcoholic or athletic. It is, of course, better to postpone the operation until the patient is in better condition if possible. But if this is impossible in the emergency, a moderate dose of morphin, depending on the conditions present at the moment, is very helpful in relieving the bodily demands for oxygen and rendering the anesthesia safer and easier. Slow induction with gradual reducing percentages of oxygen leading into the desired plane of anesthesia is the logical and safe procedure.

PULMONARY DISEASES

Chronic pulmonary tuberculosis may be suspected from the character of cough and the sputum, slight afternoon fever, flushing of the cheeks, loss of weight and general weakness. A careful physical examination by a physician may be required to make the diagnosis except in the well-advanced stages. It is only in the late stages that any special deviation in the technic of anesthesia is required. Here, efforts are directed to prevent labored respiration by the administration of morphin, one-sixth grain, forty-five minutes before anesthesia, a light nitrous oxid-oxygen administered with care to prevent obstructive and ineffective breathing.

Asthma is not an infrequent complication of an extraction case. Various conditions are included under the term asthma, but none, in my experience, require any special technic for nitrous oxid-oxygen anesthesia except the use of adequate pressure to enable prompt anesthesia and to promote easy inhalation. On several occasions, the anesthetic has been administered during the labored breathing of a continued attack, which in each case has been relieved during the anesthesia. Owing to the poor

ventilation or, in some types of cases, to the slow absorption of the gas, the development of full anesthesia is often somewhat slower than normal.

Extraction is rarely necessary in a case of pneumonia, but if it is necessary, nitrous oxid-oxygen may be administered by the usual technic, but with special attention to secure light anesthesia. In my opinion, ethylene should not be used here, since it excites a flow of mucus.

In chronic bronchitis, there is no special technic required. In acute choryza, laryngitis or bronchitis, it is better, if possible, to postpone the operation until the acute symptoms subside, not because of the anesthetic but because of the possible extension of infection.

HEART DISEASE

A really dangerous heart condition is infrequently encountered by the dentist, but may be recognized by a very rapid, very slow or very irregular pulse, with swelling of the legs and ankles (pitting on pressure) and great shortness of breath on slight or no exertion. Great shortness of breath and great irregularity when found together are very important cardiac signs. In anesthetizing such a patient, light nitrous oxid-oxygen anesthesia, with plenty of time for careful induction to discover the best mixture, is essential. Deliberate, careful operating, guarding against any encroachment on free breathing, is necessary. I have never seen a well-advanced cardiac case damaged by a careful nitrous oxid-oxygen anesthesia.

DIABETES

Diabetes should be discovered and recognized for the influence it may have not so much on the anesthetic technic as on healing. The history is usually significant if it is learned that large amounts of water are drunk and particularly if the patient drinks during the night and craves sweets. Such a history calls for blood and urine examinations before operation and the administration of insulin by one acquainted with this treatment, before and for some days after the operation. No special deviation from the usual technic for nitrous oxid-oxygen anesthesia is required.

HYPERTHYROIDISM

As infected teeth are sometimes responsible for an aggravation of this condition, many of these cases are sent to the dentist before removal or treatment of the thyroid gland. The degrees of toxemia range from slight to fatal cases. The moderate case may pass unnoticed unless care is taken to detect it. Sleeplessness, flushing of the face, fine tremor of the hands, with slight enlargement of the neck, bulging of the eyes and a high metabolic rate should warn of the presence of this disease. Excitement, pain or worry markedly aggravates the condition in this disease. They are best controlled by a preliminary dose of morphin, one-fourth grain, three-quarters of an hour before the operation, and a light nitrous oxid-oxygen anesthesia. It is wise, in severe cases, to complete the operation within fifteen minutes if possible, and to do what is to be done at one operation, since anxiety over another impending operation may be a serious handicap to the patient's recovery.

THE PREAPOPLECTIC STATE

This condition may be suspected in a patient with tortuous arteries over the temples, and having sudden attacks of great shortness of breath and high blood pressure with a history of kidney disease. In most advanced cases, the complexion is muddy. A dose of morphin,

one-fourth grain, three-quarters of an hour before, and normal anesthesia under nitrous oxid-oxygen, with particular care to avoid any interference with breathing during the operation, which is the greatest factor in increasing the blood pressure, is the best procedure. Epinephrin and similar drugs must not be used, for the same reason. A number of my patients who have already had one or more strokes of apoplexy have been handled in this manner without the development of an apoplectic seizure during or immediately after the operation. These cases are often relieved, temporarily at least, by the removal of infected teeth, and are rather frequently referred to the dentist by the physician. The patients are often alcoholics, which renders the anesthetic more difficult and more dangerous unless morphin is used before the operation to reduce the blood pressure and render the anesthetic technic normal.

INFECTIONS OF THE NECK AND AIR PASSAGES

Brawny indurations of the jaw or neck from extensions of an acute infection may be of such magnitude as to endanger life from asphyxiation. When extraction of the tooth or other means of drainage becomes necessary under these conditions, assistance to breathing by administering the gases under considerable pressure is very important. It may be life saving. To secure such assistance to inspiration, the mouth pack should be firm and well placed to keep the gases under pressure in the pharynx. In some of these cases, the floor and base of the tongue are so swollen as to serve these purposes of the pack. Light anesthesia is here indicated, working at from 10 to 20 mm. (Hg) pressure, as relaxation of muscles in deep anesthesia further embarrasses the already labored breathing. In hospital cases, respiration may fail if a bed-ridden patient is placed in the upright posture, cerebral anemia resulting, simulating a prolonged faint or syncope. Inflation of the lungs with oxygen and restoration of a recumbent posture is required to restore satisfactory breathing.

Neck growths and tumors pressing on the trachea, and other obstructions, always call for a similar technic of administration, for the same reasons.

RESPIRATORY OBSTRUCTION: A CASE REPORT

Some years ago, a young woman came in with two lower impacted third molars. An attempt had been made to remove one of the teeth under block anesthesia, but she was unable to let the surgeon continue his operation for some reason which was not clear to us at the time that she related her experience. Another surgeon, she explained, had failed in an attempt to anesthetize her with nitrous oxid-oxygen. On starting the nitrous oxid-oxygen anesthesia on this patient, we discovered that she was unable to breathe, although she was making strong efforts to do so. Following our usual method to assist the patient under such circumstances of apparent obstruction, the gases were instantly placed under a pressure of about 20 mm. of mercury, when suddenly she was able to breathe freely. Anesthesia promptly followed, and when the mouth cover was removed, we were astonished to see the uvula fluttering in the mouth just behind the incisors. After the two teeth had been removed, and administration of the anesthetic was discontinued, the uvula dropped down the throat out of sight, there remaining a curtain of soft palate separating the oral cavity from the pharynx. It was then discovered that this patient never had been able to breathe when her mouth was open, which explained the two previous failures.

ANESTHESIA IN CHILDREN

Young children require from 2 to 3 per cent more oxygen than adults. A

few breaths of nitrous oxid, followed by 10 per cent oxygen in the mixture, produce satisfactory anesthesia in a surprisingly large proportion of children under 10 or 12 years of age, as observed in our dispensary clinic.

ANESTHESIA IN THE INSANE

Insane patients react as normal adults and are influenced by the same factors of drug addiction, alcoholism, etc., as the sane. Patients from the "strong wards" rarely require restraint, but occasionally it requires considerable force to hold the patient in the chair until anesthesia is secured, after which they respond as sane patients.

PREMEDICATION

In the management of some of the handicapped cases referred to, mention was made of the use of morphin prior to the operation. This does not refer to the average dental case in the office. Morphin is advantageous in relieving excited patients, in lowering an elevated metabolic rate, in rendering alcoholic and athletic patients normal in their response to anesthesia and in lowering the demand for oxygen in anemic and in cardiac cases. It should ordinarily be combined with one one-hundredth grain hyoscin in adults up to 60 years of age, or given alone; the tablet being placed under the tongue for absorption about one hour before the operation or administered hypodermically. Atropin with morphin is not used unless there is a pulse rate below sixty. The dose of morphin used should be sufficient to render the patient drowsy and carefree, which, in the average adult, is one-fourth grain and one one-hundredth grain of hyoscin. Larger doses may be required in some cases of hyperthyroidism.

The objections to the use of this drug in office cases are:

1. There is increased nausea after operation and delay in evacuation from the office. There is less nausea in hospital cases because the patients remain quiet and recumbent.
2. There is unnecessary drugging for ordinary dental cases.
3. Delay is occasioned after administration, before beginning operation.

EVOLUTION OF GENERAL ANESTHESIA

The history of anesthesia has been punctuated by periods in which first one anesthetic and then another was employed, the anesthetists always seeking the perfect but often returning to a previous agent.

When Horace Wells took nitrous oxid while Riggs, another famous dentist, removed his tooth, the dental profession began the use of an anesthetic agent which it has at no time completely abandoned.

For short anesthesia, nitrous oxid remained the anesthetic for the extraction of teeth, while ether, chloroform, mixtures of ether and chloroform and then again ether claimed periods of popularity with the medical profession up to about 1920.

When E. Willys Andrews mixed nitrous oxid with oxygen in 1868, the barrier to its use in prolonged anesthesia was removed. It remained for Hewitt in England and Teter in America, about thirty-five years later, actually to urge it as an anesthetic for long operations, and to devise apparatus with which it was possible to control the mixture or dose sufficiently for fair results.

Although nitrous oxid, since 1844, has been in continuous use by the dental profession, there have been similar waves of rather extensive use of other anesthetics,

such as ether, chloroform, ethyl chlorid, somniform and ethylene-oxygen, and local and block anesthesia. Following the use of each of these, there has been a return to nitrous oxid, and finally to nitrous oxid-oxygen, which in itself is significant clinical proof of the safety and adaptability of this anesthetic for dental work.

In continental Europe, where regional, spinal and local anesthesia have been in vogue among general surgeons for years, nitrous oxid-oxygen is beginning to grow in popularity. In this country, in medical circles, nitrous oxid-oxyen and ethylene oxygen are in a contest for popularity. A survey of ten points of strength and weakness in each may be of interest and assistance to the dental profession.

1. Nitrous oxid-oxygen and ethylene-oxygen are about equal in the time required for induction.

2. Nitrous oxid is practically odorless, while ethylene possesses a garlic-like, offensive odor to one not accustomed to it, which is a handicap in the dental office for private cases. In the hospital, this is a matter of choice for the patient, since there are often other odors quite as bad. The bystander, surgeon, nurses or assistants often complain of headache after the first few exposures to ethylene.

3. Nitrous oxid-oxygen is noncumbustible, while ethylene-oxygen in any proportions is combustible and in certain mixtures is explosive. Although relatively few fires or explosions have occurred during ethylene-oxygen anesthesia, this factor limits its hospital use in certain operations and where sources of ignition are present in the room. This also curtails its use in the dental office.

4. Muscular relaxation, an important factor in general surgery, is obtainable with nitrous oxid-oxygen to a moderate degree when combined with careful management of the anesthetic and preoperative hypnotics; while administration of ethylene-oxygen, in some cases, results in excellent relaxation, and in others, in no better or not such good relaxation as nitrous-oxid-oxygen affords under equal conditions of administration. Since muscular relaxation in the surgical sense is not required in dental surgery, ethylene loses its advantage here.

5. Ethylene is slightly better for the carbon dioxid absorption method with rebreathing than is nitrous oxid. Either can be administered with less than 30 gallons per hour consumption by this method. This advantage is not open to dental operations for two reasons: 1. The average dental case is finished before body saturation is sufficiently accomplished to use it. 2. An air-tight face inhaler or intratracheal tube is required to eliminate the need of pressure administration to exclude air. The face inhaler is out of the question in prolonged dental cases and the intratracheal catheter requires too much trouble for insertion for its general use by the dentist at present.

6. As in ether anesthesia, a light anesthesia with ethylene-oxygen is often impossible because vomiting is produced; while nitrous oxid-oxygen rarely produces vomiting in the light and normal planes of third stage anesthesia, and is therefore an advantage in all cases of anemia, cardiac or other physical states requiring light anesthesia.

7. It is claimed that ethylene-oxygen is as nearly free from effects on various tissues and organs as is nitrous oxid. This has not yet been fully proved by time and use.

8. The technic and equipment for one is practically the same as for the other.

9. The pulse, respiration and blood pressures are lower with ethylene than with nitrous oxid-oxygen in about 50 per cent of the cases, but this effect occurs about ten minutes or more after induction rather than at the beginning.

10. Recovery of consciousness is accomplished in less time, with much less nausea or vomiting, and quicker evacuation of the patient from the office after nitrous oxid-oxygen than after ethylene-oxygen. This is an important factor in dental practice when the patient expects to be quite comfortable and ambulatory immediately after the extraction.

PRIMARY ANESTHESIA

In the extraction of two or three teeth, anesthesia is induced, extraction performed and consciousness restored in a period of five minutes, or even less in the ordinary case. Primary anesthesia here suffices.

In this short interval, not much more than the most actively circulating blood is saturated with nitrous oxid or ethylene, which augurs for a prompt return of consciousness and early evacuation from the office.

Primary anesthesia is secured by the inhalation of pure nitrous oxid for from ten to twenty breaths, followed by a mixture of from 7 to 10 per cent oxygen (sometimes more), mixed with the nitrous oxid and administered under a sufficient pressure throughout the operation to prevent the inhalation of any air through the mouth and mouth pack. If the operation requires more than three or four minutes, primary anesthesia may merge progressively into a more complete anesthesia without any noticeable change in respiration or other signs. But if there is any interruption to free and easy breathing either by operative manipulation, the pack, the tongue or the position of the jaw and head, sufficient introus oxid escapes from the blood into the tissues to lessen the quantity in the brain and blood, and the patient during this interval tends to recover from the anesthesia. When this takes place, the impulses from the operation begin to influence the respiration further and there occurs an interruption of tranquil progress toward complete anesthesia. Under such circumstances, it is usually better to wait until free breathing is reestablished by correcting the position of the head, jaw and air passages, until complete anesthesia is secured.

SECONDARY ANESTHESIA

If it is known at the beginning that a protracted period of operative time will be required or that the patient is a resistant type from habits or physique, more time for complete anesthesia should be allowed before starting the operation rather than depending on a smooth transition from primary to secondary anesthesia while operating. Thirty seconds or a minute more is all that is usually required.

It is this transition period which has lately stimulated the use of carbon dioxid. Some are using it without knowing either its pharmacology or the amount that is safe, and already reports of deaths from its use are coming in.

The principal signs of anesthesia which guide in the administration will be found in the accompanying table.

Where it is difficult to secure a smooth anesthesia in a patient, it has been found helpful to reduce gradually the percentage of oxygen after primary anesthesia is secured until some sign of profound anesthesia begins to be manifested. This

McKesson's Nitrous Oxid-Oxygen Sign Chart

Light Anesthesia Due to too much oxygen in the mixture.	Normal Anesthesia Due to a properly balanced mixture of N_2O-O.	Profound Anesthesia Due to too much N_2O in the mixture or to partial obstruction of respiratory organs.
Respiration (a) Superficial slow breathing usually regular. (b) Prolonged inspiration. (c) Phonation due to reflexes or pain. (d) Holding breath, grunting.	Respiration (a) Full "machine like" respirations. Regular and faster than normal. (b) Inspiration and expiration nearly equal. (c) No phonation. (d) Continuous uninterrupted respiration.	Respiration (a) Irregular rhythm (sobby) usually slower than normal. Spasmodic. (b) Prolonged expiration. (c) Phonation due to muscular spasm of vocal cords. Often crowing. (d) Cessation of respiration from spasm of muscles of exhalation.
Muscular Phenomena (a) Movements or rigid muscles. (b) Facial expression of pain or consciousness. (c) Nausea, very rarely. (d) Reflex, or voluntary distance.	Muscular Phenomena (a) Immobile and relaxed, but having normal muscular tonus. (b) Expression of normal sleep. (c) Quiet. (d) Quiet. Relaxed.	Muscular Phenomena (a) Clonic movements, twitching or jerking in early minutes of induction, often start in upper eyelids. (b) Expression wild looking. (c) Swallowing, retching or vomiting, common. (d) Tetanic, spasm, marked rigidity — opisthotonus in some cases.
The Eye (a) Pupils large contract to light actively. (b) Conjunctive sensitive. (c) Eyeballs roll quite rapidly. (d) Eyelids resist opening, wink when touched.	The Eye (a) Pupils small or medium fixed. (b) Conjunctive insensitive to touch. (c) Eyeballs fixed downward or slowly roll. (d) Lids often slightly open, relaxed, no winking.	The Eye (a) Pupils fixed, enlarge progressively and finally become irregular in shape. (b) Conjunctive insensitive. (c) Eyeballs fixed in some position or jerk. (d) Eyelids stiff. Often wide open.
Color in Skin (a) Pink or no change normally. (b) In anemics, no color change. (c) In plethorics, slight cyanosis.	Color in Skin (a) Varies from pink to decided cyanotic tint. (b) In anemics, no color change. (c) In plethorics, considerable cyanosis.	Color in Skin (a) Usually cyanotic. (b) In anemics, slight flushing, rarely cyanosis. (c) In plethorics, almost black.
Remedy Decrease the percentage of oxygen in the mixture.		Remedy Increase oxygen in the mixture or in (d) inflate lungs with pure oxygen 1 to 3 times.

is the minimum oxygen percentage. The optimum oxygen mixture required to maintain tranquil sleep is usually good for about twenty minutes, then from 1 to 2 per cent more oxygen must be added if one is to maintain relaxation and very smooth anesthesia. The tendency to operate under light anesthesia is more prevalent among dentists than necessary except in handicapped patients. Those who are successful in their management of patients under nitrous oxid-oxygen and to less degree under ethylene-oxygen may attribute their success to the use of enough pressure to prevent air dilution or inhalation through the mouth and to a proper mixture and the careful maintenance of a clear airway for respiration.

CONCLUSION

It may be stated that patients who are too ill to be operated on in the office may require a slightly different preparation and technic of anesthesia than the ordinary ambulatory or otherwise normal case. The essential difference in most cases is greater care in producing the light plane of the third stage of anesthesia, and, in some cases, the use of morphin prior to operation to render anesthesia easier and safer, particularly in the alcoholic or athletic who is also the subject of anemia, cardiac, hyperthyroid and other complicating conditions.

The physical condition of any patient who is unable to be handled in the dental office should be inquired into before any operation, and efforts should be made to meet the conditions by appropriate technic and treatment.

The dentist might profitably follow the hospital and general surgeon in taking every patient's history and physical findings into consideration. Your fees are still too low for this care, lower, in fact, for your services, office equipment, etc., than the ordinary operating room fee alone.

DISCUSSION

E. L. Moravec, Cedar Rapids, Iowa: The greatest danger to the patient is the unknown ability or action of the operator or anesthetist. One of the greatest and most important factors of the science of anesthesia is a careful diagnosis or classification of each patient coming under your care. It is my custom to make a mental classification of each individual coming in for anesthesia or an operation. If our patients are properly classified, we at once have a basis of reckoning for the technic of our anesthesia. We have a few simple aids at hand: the history of the patient, the presence of certain pathologic conditions, pulse rate, blood pressure, pulse pressure, breath-holding test, hemoglobin index and others. These things, when charted, serve to fix the attention of the anesthetist and operator as to oxygen needs of the patient. Even after administration of many thousands of anesthetics, we are sometimes of the opinion that the great risks are the exceptions, even in dentistry and oral surgery. The average exodontist and anesthetist takes many cases that are anything but safe risks. Fatalities still occur in dental chairs and on operating tables even at the hands of the more skilled anesthetists, which indicates that the condition of the patient has become the prime factor in determining the risk involved. It also indicates the need of still greater precaution in the use of anesthetics and the need likewise of more skilled anesthetists. The anemic type, in combination with diabetes or nephritis, presents one of the most difficult types we meet, as many of our standard anesthetic guides are lost in these types. We can at no time depend on mechanical percentages as a standard guide for our dosage of oxygen or nitrous oxid. In all cases, but especially in this type of case, it requires sound judgment and exceptional skill on the part of the anesthetist to read the barometer, which is the patient, for all storm or fair weather symptoms. The comparative study of nitrous oxid-oxygen and

ethylene-oxygen is of considerable interest. Ethylene has its drawbacks even though it may be considered a more nearly ideal anesthetic than nitrous oxid. It still carries with it the explosion danger. I believe that ethylene will not displace nitrous oxid-oxygen in either hospital or office work. With the cooperation of the operator, and premedication, and in the hands of a skilled anesthetist, as much can be accomplished under nitrous-oxid as under ethylene. In my own practice, I am using ethylene principally as a synergist to nitrous-oxid, employing it only in the most obstreperous cases, believing that, in combination, a little more anesthesia can be assured and a little more relaxation can be secured. Premedication is also an important factor. I agree that it should be used only after careful study of the patients and their needs and a thorough knowledge of the medicament to be used. Often, a routine premedication is used such as a combination of morphin and atropin without the careful study of the patient's condition or needs. Chlorotone is also often indiscriminately used. It has a valuable place but must be used with caution. It is well known that mouth operations, such as extraction of teeth, oral surgery or throat surgery, present the most difficult problem for the anesthetist and can be successfully accomplished only with perfect cooperation and sympathy on the part of the operator and the anesthetist. In extraction, the pack and manipulation of the airway are most important. The pack properly adjusted accomplishes a three-fold purpose: (1) forcing of nasal respiration; (2) controlling of hemorrhage, and (3) protection against the loss of teeth or fillings in the throat or trachea. It is my practice to pack the throat in absolutely every case, even though it might be merely the extraction of a deciduous tooth. Each oral surgeon or exodontist or even general surgeon should make a careful study of the subject of anesthesia that he may be more able to cooperate understandingly and sympathize with the problems of the anesthetist; which is fully as important as the operation itself. Dr. McKesson's nitrous-oxid and oxygen sign chart is the most compact chart that I have ever seen and is well worth while studying, even for the skilled anesthetist.

PORCELAIN JACKET CROWNS*

By HAROLD W. OPPICE, D.D.S., Chicago, Ill.

SINCE the advent of the "Land" crown in 1895, much has been written regarding the success and failure of porcelain for individual crowns. In its early use, repeated failures were encountered, and it has been through great perseverance on the part of a few tireless workers that porcelain has risen to a position far beyond that held by any other dental restorative material.

It is true that the porcelain jacket crown is not used by general practitioners so extensively as its many desirable qualities would suggest. Many men either believe that they lack the ability to master the trying technic of preparing or constructing them, or else they are quite satisfied to let others lead while they merely stumble along in the vanguard. To the satisfied stumbler, I have little to offer; but to the others, let me say that, contrary to the general belief, one does not have to be a born artist to construct a satisfactory porcelain jacket crown. Most of those whom we are pleased to designate as artists

*Read before the Section on Operative Dentistry, Materia Medica and Therapeutics at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 22, 1928.

were not born to their position, but achieved it through long years of study, close application to details and hard work. E. Coles Phillips, one of our greatest illustrators, claimed that, "anyone on earth, provided he was not crippled, could learn to draw, to depict what he saw."

We of the dental profession who would attempt to master the technic of restoring lost tooth structure with porcelain must learn, as the artist learns, to depict what we see. We must work out for ourselves and follow a definite plan of preparation and crown construction which will, in our hands, produce satisfactory results. The result obtained would be willing to spend a reasonable amount of time and care to master it. This technic divides itself into two different steps: one of operative tooth preparation, and the other of prosthetic crown construction. Because of a dentist's experience with other operative procedures, this first step should be the easier to master, but in practice it is the one most frequently slighted. More porcelain jacket crowns have failed because of faulty tooth preparation than because of improper construction. The foundation must be well laid or the superstructure is bound to fall.

For convenience of explanation, the crown of the tooth is divided arbitrarily

Fig. 1.—Foil held in position on labial surface.

Fig. 2.—Incisal triangle cut away.

is the important point, while the method of securing it, whether it be yours or mine, makes little difference as long as we adhere to certain fundamentals.

The fundamental requisites are the same in ceramics as in any other dental restoration; namely—strength, esthetics and compatibility with the surrounding structures. There is little doubt in the minds of those experienced in working with porcelain that it satisfies these three fundamental requirements better than any other restorative material at our command.

With the thought that porcelain jacket crowns are more often indicated than they are now employed, the following technic is presented as workable and successful for the general practitioner who

into a visible portion and an anatomic portion. The visible crown is that portion which is not covered by supporting structures. The anatomic crown is that portion which extends from the cementoenamel junction to the incisal edge.

INDICATIONS

Porcelain jacket crowns are indicated on any anterior tooth whose supporting structures are healthy, where an accident, malformation or decay has caused its crown to become unsightly and beyond hope of being restored to normal function by a less radical restoration. They are also indicated on bicuspids and molars in the same conditions, where esthetics is demanded and the economic condition of the patient will permit.

Roentgenograms and study casts should be made of all cases; and, from these, pulp location and vitality, length and strength of occlusal forces, and any deviation from normal tooth alinement should be recorded.

ANESTHESIA

Where conditions will permit, no anesthesia should be used, and many cases will be found which may be satisfactorily prepared without undue pain by means of playing a stream of warm water over them during the use of stones and discs. Where local anesthesia is necessary for the comfort of the patient, extreme care should be exercised to prevent overheating and injury to the pulp that might later result in its death.

Fig. 3.—Cutting incisal lip.

PREPARATION OF ANTERIOR TEETH CONTAINING VITAL PULPS

The contact surfaces, if present, are removed with a "lightning" disc, after which the bell of enamel on the proximal side is removed with a "Joe Dandy" safe side disc. Care is taken to avoid the making of any shoulder at this time. The visible crown is next shortened (Fig. 4) one-fifth to one-third of its original length with a "heatless" carborundum wheel stone. The age of the patient, position of the pulpal horns and length and strength of occlusion forces should be the guides in this step. Removal of the enamel on the labial is accomplished first by cutting a small groove through the enamel at the base of the visible crown with a small, knife-edge stone; secondly, by cutting a similar groove from the one just previously made to the incisal edge and close to one of the proximal surfaces; and, thirdly, by inserting a small chisel in the last groove made and chipping away the enamel. A continuance of this procedure across the labial surface will remove this portion of enamel in most cases.

Removal of the enamel on the lingual surface of the visible crown is accomplished first by making a groove at its base similar to the one made on the labial surface; second by grinding away the bulk of enamel at the cingulum; and third by grinding with an inverted cone shaped stone, using a pull motion, starting in the groove at the base and finishing at the incisal portion. This surface is by far the most difficult from which to remove the enamel and its preparation is completed only by several repetitions of the pull motion with the inverted-cone-shaped stone.

Fig. 4.—Incisal lip burnished.

The enamel that remains on the anatomic crown is now removed (Fig. 10) unless it is found that some of the supporting structures are attached to this portion of the tooth, in which case this enamel is left intact and thus prevents recession of the gingival tissues. The removal of this enamel, when indicated, is accomplished with small enamel cleavers such as Johnson's Nos. 1 and 2.

Root files of the prophylactic type are used to render the dentin smooth on this part of the tooth. At this point in the preparation, a seamless copper band of 36 gage that will fit the anatomic crown closely is selected and festooned, the labial portion being marked with an X for later identification.

The formation of the shoulder to correspond to the tissue festoon is now undertaken. A small depression is made completely encircling the tooth at the base of the visible crown with the Evans' gingival trimmers. A Joe Dandy disc may be of assistance on the mesial and distal surfaces. A definite width is given to the shoulder by means of a plain fissure bur, No. 56. The width should not be greater than the diameter of the No. 56 bur except where decay has penetrated to a greater depth. An end-cutting bur, No. 900S, is now used to carry the shoulder beneath the free margin of the gum so that the junction of the artificial crown and the natural tooth will not be visible, care being taken not to injure the supporting structures.

The preparation is completed by making the surfaces thoroughly smooth and by beveling the incisal surface lingually on the upper and labially on lower teeth, so that the occlusion forces will strike this plane at right angles.

Fig. 5.—Wrapping foil around mesial and distal surfaces, bringing the two ends together in the center of the lingual surface.

Fig. 6.—Cutting away the excess foil at the incisal edge.

PREPARATION OF PULPLESS TEETH

The porcelain jacket crown was originally devised to replace the enamel of teeth containing vital pulps, while dowel crowns of the Richmond, Logan and Davis types were utilized for pulpless teeth. The later type of crown as usually adapted has proved to be a constant source of irritation to the soft tissues, infection and the formation of pyorrhea pockets resulting. I do not advocate them except when the financial condition of the patient will not permit of the greater expense incident to the construction of porcelain jacket crowns. In their stead, I would recommend a porcelain jacket crown of core construction with no metal in direct contact with the soft tissues and an accurate adaptation at the gingival margins.

Full Core Method for Anterior Teeth.—The surface of the root should be dressed with a carborundum stone so as to be on a level with and conform to the festoon of the soft tissues surrounding it. Any remaining enamel is removed with small enamel cleavers. The root canal filling is removed to a depth sufficient to accommodate a dowel the length of the completed crown. A groove is then cut in the pulp chamber in a labiolingual direction to key the core and to prevent its rotation. A precious metal dowel is selected and fitted to the canal

of the tooth, it being allowed to protrude about 2 mm. above the face of the root. Inlay wax is adapted to the dowel and face of the root, care being taken to secure an accurate impression of the groove in the pulp chamber. The wax is carved to resemble the form of the space previously occupied by the dentin of the crown, except at the gingival portion, where a definite shoulder of tooth structure is left protruding beyond the wax. This shoulder may be slightly wider than that made in preparing a tooth containing a vital pulp. The wax core, with the dowel attached, is next removed, cast in gold, polished and cemented to place, thus giving a well formed dentin portion firmly anchored in tooth structure. The shoulder of tooth structure is now carried beneath the free margin of the gum as for a tooth containing a vital pulp.

Fig. 7.—Trimming the excess foil on the lingual surface to within 2 mm. of the crease.

Full Core Method for Posterior Teeth.—As a great many posterior teeth have diverging canals which preclude the removal of dowels and core in one piece, the following method of rebuilding the lost dentin in these teeth with precious metal cores is given. After the gingival portion has been dressed level with the contour of the soft tissues, the pulp chamber is made box-shaped and the two larger canals are enlarged for the reception of the dowels. Two dowels of 18-gage precious metal are oiled and adapted to these canals, one-half inch protruding from the pulp chamber. Wax is then adapted over the dowels and into the pulp chamber and carved to resemble the original form of the dentin. While the wax is still in place on the tooth, the dowels are removed (the oil permits this without distortion) and replaced with carbon points. The wax and carbon points are now removed intact, invested and cast in gold. After casting, the carbon is removed with a round bur, two holes being left for the insertion of the metal dowels. The core is cemented to place, and while the cement is still plastic, the dowels are pushed to place, locking the core permanently in position.

Fig. 8.—Pinching the foil together in the center of the lingual surface.

Partial Core Method.—In a relatively large number of teeth in which the pulp has been destroyed, enough dentin still remains that we may utilize it as a base upon which to build a partial core of metal. As this remaining dentin, no matter how much or little, has been materially weakened by the loss of the pulp and the subsequent cavity enlargement through which root canal treatment was accomplished, it must be strengthened. A dowel of precious metal is prepared as in the full core method, and wax is added to it so that it will replace the lost dentin. This partial core is cast in gold and cemented to place.

IMPRESSIONS

An impression of the preparation is secured in impression compound as fol-

lows: Center the copper band previously fitted so that it will completely enclose the entire preparation. Fill the band with stick impression compound made plastic with dry heat. Hold the band on the labial and lingual surfaces with the thumb and second finger of the right hand and carry it to place. Close the band and compress the compound at the incisal portion with the index finger of the left hand. Chill the compound with a stream of cold water and trim off the excess compound at the gingival margin with a fine explorer. Remove the impression and examine it for accuracy. An accurate impression will show a distinct outline of the entire shoulder in the impression compound which was enclosed within the band.

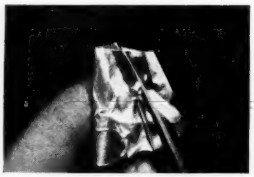


Fig. 9.—With the right side of the foil turned back, the left cut to within 1 mm. of the crease.

Fig. 10.—Turning the long right side over the short left side with the second finger of the right hand.

Inlay wax is adapted over the preparation and carved to resemble the original tooth form, care being taken to have the wax form adapted at the shoulder so that it will not be displaced by the soft tissues. With this wax form in position, a plaster impression is obtained, allowing the wax form to come away in the plaster and thus serve as an accurate seat for the amalgam die. A compound impression of the teeth in the opposite arch should now be secured and a registration of central occlusion obtained in bite wax.

SELECTION OF COLOR

Color is any one of the hues of the spectrum, or a tint produced by the blending of these hues. Unfortunately, perhaps, our teeth are tinted, and if we would attempt to reproduce their color accurately, we must know something of colors and how to blend them. We must first ascertain our ability to distinguish one color from another and determine whether or not we are color blind. A color blind person is classed as a cripple by the artist and is wholly unfit to match colors. In selecting the particular hues which we may find in a tooth, it is desirable to know certain definite laws governing colors. First, we should remember that "false" colors are produced by the affinity of one color for another. This necessitates blocking out surrounding colors of the face by a neutral gray mask during the time that the correct shade is being ascertained. Secondly, a successful matching of colors is accomplished only in average daylight; and we find it necessary in our work to employ a north light. Thirdly, colors that are being matched should be placed in the same immediate environment; which makes it necessary for us to bathe in moisture both the tooth and the shade guide during the matching process. A chart of the labial and lingual surfaces should be made on which is recorded definite gingival and incisal colors. Peculiar tooth contour and markings also should be indicated on this chart.

TREATMENT OF THE PREPARED TOOTH

Before the patient is dismissed, a thin coating of cavity varnish should be painted on the entire preparation, over which a celluloid crown form filled with either a temporary filling or silicious cement is adapted. This temporary crown will afford ample protection to the pulp and also permit the patient to make a presentable appearance in public.

DIE AND CASTS

The impression obtained in the copper band is now packed with amalgam, care being taken to build up a long root portion. After the die has hardened sufficiently to separate, it must be trimmed and keyed. The die is then seated in the wax form of the plaster impression and held in place with sticky wax on the lingual surface, and from this a plaster cast is obtained. A plaster cast is also obtained from the impression secured of the opposite arch and articulated with the previously made cast.

Fig. 11.—Tinner's joint half completed; three thicknesses of foil.

Fig. 12.—Tinner's joint completed; four thicknesses of foil.

CROWN CONSTRUCTION

A piece of platinum foil, 0.001 inch thick, is cut in a diamond shape, of sufficient size to cover the entire crown portion of the die. The platinum foil is held on the labial surface of the die with the thumb and first two fingers of the left hand until the joint (Tinners) is completed on the lingual surface. The cutting, folding and burnishing of the platinum can be best explained pictorially. (Figs. 1-17.)

Building the Porcelain.—A veneer of thin shellac is next painted on the shoulder of the platinum foil to prevent the porcelain from adhering to it and causing it to warp. Several brushes and carvers of different sizes are used in applying and contouring the porcelain. A quantity of porcelain powder of any color is placed on a glass slab to be used in absorbing the excess moisture from the mix immediately after it has been applied to the form. High fusing portions of the gingival and incisal colors are selected, placed in different colored dappen dishes, and mixed with distilled water to a creamy consistency. The coronal portion of the form is now painted with a thin coat of the gingival colored porcelain, and dipped in the absorbing powder for a moment. The absorbing powder is then brushed off. Additions of the gingival color are now added to the form, and as each addition is made, the opposite side of the crown is touched to the absorbing powder, and thus the excess moisture is drained out and the grains of porcelain are packed tightly together. Although the entire form is covered with gingival colored porcelain, only the gingival third of the crown should be built to actual contour at the first application. All trace of powder should be removed from the apron of the form (the apron being that portion of

the form rootwise to the shoulder). The platinum form, with the first application of porcelain, is carefully removed from the die, placed on a fire-clay slide and allowed to dry on top of the heated muffle. The slide is placed in the muffle, and the door left ajar for two minutes to allow the gas formed by the burning of the débris to escape and thus avoid "gassing" the porcelain. After the muffle door is closed, the temperature is increased to within 100 degrees of the fusing point of the porcelain. Before making the second application, the platinum is reburnished to the shoulder of the die; after which, porcelain of both

Fig. 13.—Apron trimmed to within 1 mm. of the shoulder.

gingival and incisal colors are added. Contour and shading are now the most important points to be observed. After the die has been frequently returned to the casts to insure proper contour, a second firing is given the crown similar to the first. After this firing, it is advisable to try the crown with the form in place in the patient's mouth to note any serious faults in the contour. Slight grinding may be indicated in some places; while others may require an added amount of porcelain. When all subtractions and additions have been made to the operator's satisfaction, the crown is returned to the furnace and glazed, after which the platinum is removed.

Mounting the Crown.—A cementing substance should be chosen which has both strength and translucency. This is easier said than done. I do not know of a cement on the market today that will perfectly answer these requirements. Any good oxyphosphate cement the same color as the gingival porcelain may be used. If the shade of the crown is poor and the color of the cement is selected to correct this defect, the result is never satisfactory. After the crown is cemented to place, the several occlusal positions of the teeth are checked for accuracy of length, in order to insure original central, lateral and incisive occlusion.

Fig. 14.—Burnishing the form with the fingers, much as a woman would fit a glove.

CONCLUSIONS

1. All who are engaged in restoring lost tooth structure should include in our armamentarium the porcelain jacket crown.

2. A porcelain jacket crown preparation should resemble the original crown in miniature, minus its bell-shape and plus a shoulder which is narrow in width and placed just beneath the free margin of the soft tissues.

3. Just as the great violinist must spend hours and hours in perfecting a technic before he can give to us his finished concerto, so must we be willing to spend some time in studying and mastering our technical problems in order to produce satisfactory results with porcelain.

1002 Wilson Avenue.

DISCUSSION

C. Carlisle Bastian, New York City: I thoroughly agree with Dr. Oppice in emphasizing the necessity of securing a proper preparation of the natural tooth. The finished shoulder, in particular, should be perfectly smooth, to permit the correct adaptation of the porcelain jacket. As regards local anesthesia, my experience has led me to adopt procain as a matter of routine practice. For anterior teeth, I use the method of infiltration recommended by Dr. Posner of New York City, and for posterior teeth, conduction anesthesia. Without procain, the cutting of the shoulder is usually a painful process for the patient and a difficult one for the operator. It seems to me to be a simple matter to prevent overheating of the tooth. For anterior teeth, I endeavor to cut the shoulder as narrow as it is possible to make it and yet have a prefectly formed uniform shoulder. This narrow shoulder conserves tooth structure but allows sufficient strength for the porcelain jacket. Fracture of the porcelain in anterior teeth usually occurs in the breaking away of a crescentric area of the labial at the gingival, extending incisally, perhaps 2 or 3 mm. I am certain that all porcelain jacket workers have occasionally had this experience. The reason the porcelain breaks here is that this part of the jacket is subjected to the greatest strain when pressure is placed on the lingual surface during mastication. In addition, it is frequently possible to prepare the tooth without removing all the convexity on the labial side, yet the impression will withdraw without distortion or fracture, on account of the incline of the lingual surface. Therefore, in the preparation of anterior teeth, the gingival two-thirds of the labial surface should be cut down with a disc so that this surface is distinctly flattened. This allows a little more bulk of porcelain in this region than if we prepare the tooth to resemble the original crown in miniature, minus undercuts and plus a narrow shoulder. Another problem we face in porcelain jacket restorations is the danger of recession of the gum. At times, after the jacket has been in the mouth for a few months, the gum may recede on the labial or lingual side, just sufficiently to show the line of junction between the porcelain and the tooth. This is usually due to a poorly fitting jacket, but it may be caused by a lack of contour or an underglazing of the porcelain at the gingival border. On the other hand, it may be caused by injury to the gum during the preparation of the tooth or by an ill-fitting temporary silicate cement crown. Dr. Oppice has given us a practical technic for the construction of jackets for pulpless teeth. Jackets are preferable to ready made crowns on account of the better esthetic results possible. At times, I find it necessary, with devitalized teeth, to use a swaged platinum coping, to reduce the possibility of a subsequent fracture of the root. Thus, an upper first bicuspid, after the completion of the root canal work, may need reinforcement to prevent a buccolingual fracture. Metal posts, metal core and the porcelain jacket can be attached to this metal coping. The prosthetic construction of the jacket described by Dr. Oppice fulfils every requirement. Each step must be perfect. Thus, a good impression and amalgam die are vital necessities. The completed crown must accurately fit the amalgam die. All alterations and additions to the jacket should be made before the crown is glazed. The porcelain should be dense and free from bubbles. The glazing is an important detail. If the porcelain is overglazed, it will present an unnatural, glassy appearance, and the fine form and colors may be destroyed. The

Fig. 15.—Burnishing around the form once, from incisal to gingival with a No. 4 burnisher.

Fig. 16.—Burnishing the form to the shoulder with a No. 22 burnisher.

question of color brings up the greatest and most interesting problem in porcelain jacket work. To present a difficult case: Suppose the restoration is a single upper central incisor. Suppose also that the upper teeth are prominently displayed and the adjoining central has a clear orange neck and translucent gray tip. The completed jacket must defy detection, regardless of the movements of the lips, and whether the teeth are exposed to different intensities of light, such as harsh sunlight, cold northern light or an artificial light. The natural crown and, more particularly, the incisal third of it will appear to change color under these varying conditions, whereas the colors of the porcelain jacket remain practically unchanged. Therefore in selecting the shades of porcelain, it is a question of general harmony, not with the

Fig. 17.—Completed platinum form.

colors of, but with the color effects in, the adjoining central. The shades are selected under a northern light exposure because this light gives the maximum expression of colors in the natural teeth. Undoubtedly, the correct shaping and positioning of the jacket is a great aid to the color problem. The surface of the jacket crown should be broken with fine lines, even though the adjoining central incisor is smooth. These fine lines will be almost eliminated in glazing, but will tend to give the jacket a more natural appearance. The color of the cement used in cementing the jacket is an exceedingly important detail. Dr. Oppice rightly states that where the shade of the jacket is poor, it cannot be corrected by the color of the cement. If the gingival shade is a little too light, this can frequently be rectified by the color of the cement. If the gingival shade of the porcelain is too dark, it has been my experience that the underlying cement will not correct it. The color that is suitable for most cases, I obtain by using a cream white oxyphosphate cement with which is incorporated a small amount of dark brown. The resulting slightly brownish tint in the cement appears to harmonize with the orange neck found in most teeth.

W. L. Fickes, Pittsburgh, Pa.: Dr. Oppice has described his methods of constructing porcelain jacket crowns in a very effective manner and it would not help your understanding of his methods were I to offer other methods or to make an attempt to amplify his description of such crowns. I wish to make one correction and to emphasize the importance of certain phases of the work which relate to the health of the periodontal tissues, the conservation of the pulp, and the durability of the crown. Dr. Oppice refers to the advent of the Land jacket crown in 1895; whereas, Dr. Land's platinoporcelain jacket crown was invented in 1886, and the all-porcelain jacket crown was introduced by Dr. Land in 1902. Dr. Spalding demonstrated the latter crown so admirably that it immediately became popular and was referred to by many operators as the Spalding porcelain jacket crown. Dr. Oppice said that "more porcelain crowns have failed because of faulty tooth preparation than because of improper construction." Failure of a jacket crown may be due to several factors; namely, faulty firing of the porcelain causing breakage which can be remedied; or injudicious cutting of the dentin causing the tooth to break or the pulp to die; either of these producing a serious result, or the tooth may not function as it should in its mutually protective relationship with the supporting tissues of the tooth. The slightest imperfection of form or roughness of the surface of a crown, especially on the proximal sides or under the free margin of the gum, will cause recession, injury and infection. Injuries to the gingival tissues during the preparation of the tooth, or from faulty tooth form, not only cause failures of crowns, but also endanger the health of patients. I would, therefore, call your particular attention to Dr. Oppice's technic as related to the conservation of the pulp and the protection of the gingival tissues. Jacket crown construction, and this is true of all operative procedure, should be based on what is worth knowing and why it is so.

Dr. Oppice (closing): As to the question of anesthesia which Dr. Bastian mentioned: I believe that he is correct when he says that, in most offices, we find local anesthesia employed during the procedure of preparing

a tooth for the reception of a porcelain jacket crown. The reason I included in the paper the point that I did not use local anesthesia, or would not advise it in a great many cases, is that I am associated with student preparations a great deal, and find that students rarely have judgment enough to stop grinding before they have injured the pulp, or experience enough to determine just where the pulpal horns are located. Therefore, if there is no anesthesia, the patient will give warning, so that the student will not injure or expose the pulp. With the more experienced dentist, the patient is undoubtedly more comfortable when a local anesthesia is used. Dr. Bastian states that he would prepare the shoulder as narrow as possible. I wonder if it is exactly wise to make that statement. We have two things to consider, one in preparing and the other in constructing this crown. We must conserve the dentin structure and we must also consider the strength of the material with which we are going to make our crown. Now, if we tell a beginner in this work to make the shoulder as narrow as possible, what will determine when the shoulder ceases to be a shoulder? Undoubtedly, all of us have seen a number of very fine looking and well fitting porcelain jacket crowns from which the soft tissues have receded, so that the junction of the artificial crown with the natural tooth is visible, and we are sure it was not visible when we cemented that crown to place. Dr. Bastian says this may be due to the poor fitting of a crown, or the lack of proper gingival contour or an underglazing of the porcelain at the gingival border, to which I agree. He then goes on to say that this condition is sometimes due to injury inflicted on the gum tissue during the preparation, and I am sure that this one thing, this injury to the supporting structures, is more often the cause of tissue recession than any other. Since 1921, we have known, or could have known, that the supporting structures of a tooth are originally attached to the enamel as well as to the cementum. Dr. Gottlieb of Vienna told us this in 1921, but we have been very slow to follow up his findings. In Orban's "Dental Histology," which has just appeared, we find the statement that, on the eruption of our teeth, the epithelium attachment is in direct contact with the enamel of the tooth, and if the tooth continues to erupt, the epithelium attachment goes lower and lower on the tooth, but still is attached to the enamel, until it passes beyond the enamel point and is attached only to the cementum. I think we have believed, for a good many years, that there was no attachment of this epithelium or soft tissue to the enamel, but if we examine a young patient around the age of 15 years by passing a probe into what we call the gingival crevice, we find that it will stop or reach an obstruction before it comes to the so-called gingival line or cemento-enamel junction. Therefore, I think that, in all of our young patients, we should not remove all of this gingival roll of enamel. I believe that this is the reason that we find so much recession around these crowns, and especially those placed in the mouths of our young people.

WHAT IS RESEARCH: RESEARCH IN FIELDS NOT DENTAL*

By EDWARD H. HATTON, B.L., M.D., and H. C. BENEDICT, M.S., Chicago, Ill.

EVERY age in art, literature and science has had its guiding star. Just as the search for the philosopher's stone and the elixir of life was directed by the murky light of avarice and eternal desire for immortality, so, today, research is the magic flame that beckons to the eager inquiring soul.

The term is used glibly, universally, to a degree that has quite divested it of significance to a large degree. No modern activity is without its disciples and apostles of research, business, industry, government and what not, as well as the sciences.

Research, after all is said, is the process by which the sum total of knowledge is increased. There are, at least, three phases to this process. Perhaps it may be compared to the trapping of wild creatures. The creation of the design, or method, and the plan, the details of setting and baiting the trap and the collection and disposal of the catch. Reason, imagination and design lead up to the collection of data and facts that require analysis, critical study and, finally, demonstration. It must be clear that no single item of this group can be characterized as research. The staging of a plan to wring an answer from nature is not research. Neither is the accumulation of data and facts alone research; nor even these two. An adequate and critical explanation and a convincing demonstration of the whole process is needed.

Research has frequently been classed as major and minor. Major research is concerned not only with the increase in knowledge but also with the discovery of a new method or new machinery capable of all sorts of variations and adaptations for increase in knowledge. Minor research has to do with the use of methods and machinery, the end-results of major researches, for the exploration of fields already worked over, but incompletely so. This may be compared to casting a stone into the water. The commotion of the entrance of the solid into the fluid is the impact of the great discovery. The ever-widening ripples, growing smaller and smaller as they spread out, measure the effectiveness of accomplishment, until the result is only infinitesimal.

It falls to the lot of few to make a major discovery. Most of us are engaged somewhere in the radiating swells that follow in the wake of the great discovery. And this is because few have the combination of a great creative imagination, tireless industry, patient persistence, absolute honesty and the gift of being able to see that which has not been seen. One must know what has been done and be able to interpret

*Read before the Section on Histology, Physiology, Pathology, Bacteriology and Chemistry (Research) at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 23, 1928.

these facts and theories and the material that he himself has accumulated.

From such an analysis, it is clear that much that goes under the name of research is not research. Particularly is this true of those who approach a problem with a preconceived notion and merely assemble facts and data to verify that notion.

Probably there is no such a thing as pure dental research. Many of the discoveries that have particularly benefited dentistry have been made in fields entirely outside dentistry, such as the discovery of the nature and application of the roentgen ray; and it is equally true that investigation in dental fields is inevitably of significance in other fields.

In order to gain some idea of the volume of overflow into the dental field from outside sources, the articles listed in the cumulative index published by the American Medical Association have been studied. In one such list, and this is typical of a total of 326 articles listed, 236 came from sources that may be denominated dental and ninety from medical sources. Of the latter, quite naturally, the preponderance was found in the fields of anatomy, eye, ear, nose and throat and focal infection.

Another method of approach was made through the chemical abstracts, and this has been analyzed by one of us (H. C. B.) recently in the *Dental Cosmos*. The overflow here largely concerns diet, vitamins and drugs such as germicides and antiseptics, and the volume is surprisingly large.

Since the recent consolidation of the Cumulative Index and the Index Medicus, a large number of dental journals are included in the subject matter indexed. Not only does this supply a bird's-eye view of the total volume of work done, but it also supplies a useful key to the dental literature on any subject. If to this is added the material in chemical abstracts, the approach to literature on dental research is made somewhat easier.

THE WORK OF THE NATIONAL SOCIETY OF DENTURE PROSTHETISTS AND ITS RELATION TO THE AMERICAN DENTAL ASSOCIATION*

By ELBERT BRITTEN OWEN, D.D.S., St. Louis, Mo.

THE consideration that prompted the writing of this paper, which presents the individual point of view of a member of both the National Society of Denture Prosthetists and the American Dental Association, is fourfold in character. The points to be considered are:

1. Is interest in the subject of full denture construction waning?
2. Is denture prosthesis being overspecialized?
3. Is there an undercurrent of dissatisfaction in the profession with the

*Read before the Section on Full Denture Prosthesis at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 23, 1928.

progress that has been made in this work?

4. What has the National Society of Denture Prosthetists to do with these questions?

To the first of these questions, I will answer that reports have been received indicating a lack of interest in some localities, while from other sections come reports of continued and renewed interest. With the idea of analyzing the situation to determine the point of view of those showing a lack of interest in the subject of full denture construction, inquiries were made, and it was found that there was a general feeling among members of the profession that the technics offered today are too complicated to be practical in a general practice; that they are too time-consuming for the average fee; that there is no agreement among those prominent in the work as to what is the best technic now advocated, and no agreement as to what is the best articulating instrument.

To the second question, the answer may be made that denture construction is not being overspecialized. Just what is meant by overspecialization was learned by contact with some who made the assertion, as follows: The subject, theoretically and practically, becomes so complicated and time-consuming that only those devoting their entire time to denture construction have time to practice it, and because of this thousands of patients not able to pay specialists fees are being deprived of the most scientific denture service. This claim cannot be substantiated because the most time-consuming technic known today would not, after a little practice by the operator, add more than a few hours to the total time now consumed in constructing a full maxillomandibular case. This time, at the fees any of us command, should not make such a difference as to prevent any one able to pay a fee at all from receiving service.

As to the next question, there surely *is* an undercurrent of dissatisfaction with the progress made in this subject. Those of this opinion feel that there is still too much dissension among the many advocates of technics, and that the much desired standardization of technic is sadly lacking. And this, they feel, is an unnecessary condition, considering the number of able men working on the subject; giving rise to the thought that personal ambition centering around the manufacture and sale of articulators is playing a great part in retarding progress; that men for selfish reasons will not yield a point for harmony and scientific advancement.

A further discussion of these considerations will be brought out in the next phase of this paper, which deals with the National Society of Denture Prosthetists; its relation to these thoughts just brought out; and its relation to the American Dental Association and the general profession.

Ten years ago, the National Society of Denture Prosthetists was organized by a small group of interested men who met in Chicago during the annual session of the National Dental Association in 1918. It was organized as a research society, its primary intention being to conduct extensive research work at its meetings. It soon developed that the amount of research work that could be done at the meetings was limited; therefore, the society was soon converted into a clearing house for the work each individual had done in his own office. The

men meet each year, and pool their ideas and experiences, and a discussion follows. That these discussions are healthy may be vouched for by any outsider who has attended any of these sessions. One advantage of an organization of this kind with rather a small membership is that the members become so well acquainted that a straightforward expression of views, even though heated, may be indulged in without the unpleasantness of personalities entering into it. Men in the society who are often of directly opposite views on scientific matters, and their arguments on the floor of the meetings often of the most heated variety, are the best of friends. Discussions of this kind have sometimes, when heard by outsiders, given rise to the rumor that the society gives all its time to contention, but such an idea is entirely erroneous.

In the earlier years of the existence of the society, there was scarcely a point in the technic of scientific denture construction on which there was wholehearted agreement. Many members were in a haze, because inexperienced in the much discussed points. Today, through study, experience, discussions and demonstrations, many disputed points have been solved to the satisfaction and agreement of the entire society. As one example of this, only a few years ago the principle of adaptability, or the establishment of conditions peculiar to each individual on an instrument, and the building of dentures to harmonize with these conditions, was neither accepted nor appreciated by a very large number. Today, this principle is almost universally accepted, and technics are devised and instruments built with this in view. Lack of time prevents enumerating many other examples.

The purposes of the society have been much misunderstood, and many expectations on the part of the profession have not materialized, for the simple reason that they have not been within the scope of the purposes of the society. For instance, we have many times been asked such questions as: When are you men going to tell us what articulator is best, what technic you are going to adopt, what impression material is best? When are you going to standardize technic, etc., etc.?

Answers to these questions will never be forthcoming from the National Society of Denture Prosthetists as long as it is constituted as it is at the present time. The society is neither judge nor jury for the profession. It is not a self-constituted authority to interpret principles, instruments and materials for the profession, and such authority has never been granted to any one by the American Dental Association.

Because the society has never given out such information, it has been accused of being close-mouthed and reluctant about disclosing its findings. To this, I may answer, if an answer is necessary, that practically every member of the society is drawn on heavily in the matter of time for attendance at meetings, where he gives freely of his knowledge and experience, much of which has been gained through his association with his fellow members of the National Society of Denture Prosthetists. And this must of necessity be the extent of dissemination through that body, since the society is only a pooling place for ideas, where they may be freely discussed. It cannot act as judge, and therefore, it cannot put out information with its own official stamp of approval. Its individual members may give out all the infor-

mation they wish as individuals, and the society encourages such action on the part of its members.

You hear much of standardization with reference to technic and principles. Principles may be and have been to a great extent standardized, but technic cannot and should not be standardized. Where standardization begins, progress stops. Had we standardized the technic of building dentures five years ago and considered our progress to that time as at an end, we would have been in much the same position as motor car builders had they stopped improvements on cars five years ago. When a thing, regardless of what it is, is not perfect, we have no right to consider it good enough and to stop trying to improve it. Fixing an authoritative standard for denture construction at the present time would be a great mistake. We must continue to make progress from time to time. Various men will continue to improve technic, and technics will continue to differ in their application, and men in the profession everywhere will have to judge for themselves which of the technics appeal most to their own powers of application.

That the various technics advocated for the construction of dentures seem complicated and difficult of application has given rise to the contention that this branch has been overspecialized, and a loss of interest on the part of the profession has been the result. If we recognize that conditions peculiar to the individual exist; and if we recognize the necessity of building dentures in harmony with these individual conditions, it must of necessity require a technic embracing several steps, more or less time-consuming. That these technics are too complicated to be mastered is out of the question. Any dentist with the ability to make an inlay or a jacket crown or a good edentulous impression is able to carry out even the most complicated technic that has been advocated; this, of course, with a little experience. Any technic seems complicated that has never been tried, but a little effort to master them renders all technics simple.

Naturally, these methods are more time-consuming. Anything done more thoroughly and more accurately, anything better fitted to the individual requirements of the patient, will require more time than less scientific procedures. But this should not cause lack of interest in a subject, but renewed interest.

The National Society of Denture Prosthetists will continue to strive, as it has in the past, to further perfect denture construction, and at the same time simplify the procedures as far as they can be simplified without loss of efficiency. In this task, we welcome any help that may come from those who are not members of this organization; and, in this connection, permit me to say that this society recognizes many men of outstanding ability who are not members.

While this prosthetic society was not organized by authority of the American Dental Association, nor does it have the official sanction of that body, we recognize the American Dental Association as our parent organization; require membership in it as a qualification for membership; hold our meetings at the same place and at a time when practically our entire membership can attend the Association meeting. We cooperate freely in the programs of the parent body, thereby giving to the dental pro-

fession for their approval such material of value as has been presented to our society, and practically at the same time. The National Society of Denture Prosthetists pledges its continued support to and cooperation with the parent body, and further pledges its efforts toward simplification consistent with efficiency. Through its individual members, it pledges the fullest measure of dissemination of such knowledge as may be disclosed at its meetings.

CONCLUSION

Until the American Dental Association authorizes some person or group of persons to interpret officially principles, technics, and instruments for the profession, such interpretation cannot be forthcoming. Surely this society cannot assume self-constituted authority in such matters.

DISCUSSION

C. N. Johnson, Chicago, Ill.: This paper of Dr. Owen's is a straightforward statement of the conditions which today exist in the full denture situation. He asks the question: "Is interest in the subject of full denture construction waning?" This brings up a consideration that confronts us in every department of dentistry. We find that there are waves of interest in the various subjects that sweep the profession periodically, and when one of these waves is in operation, our literature is filled with articles on that particular topic. Full denture work is no different in this respect from other subjects, and, during recent years, we have seen more papers on that topic than had appeared previously in a decade. If the interest is waning, it is only following the natural course of events in such matters. Who can predict what will be the next furor? Dr. Owen asks if denture prosthesis is being overspecialized. The same answer may be given to this that would be given to any other outstanding department of dentistry. Of the desirability, even the necessity, of specialization in dentistry, there can be no question. Specialization has developed the various departments in a way that never could have been approached without it. The sum total of the effects of specialization has been most beneficial, and it has become such an integral part of our professional progress that there is no argument as to its desirability. But everything good can be overdone, and there is a widespread feeling, which seems to me justified, that specialization has been overdone in dentistry. Whether or not full denture work has been specialized too much, I cannot say, but I should lament the day that this service ever becomes so intricate and complicated that it cannot be performed acceptably by the rank and file of the profession. The same thing is true of dentistry that is true of medicine—there has grown up a tendency to specialize too much in both professions, and the most useful service that has been administered by these professions in the past is threatened with extinction if present tendencies continue to prevail. There is no question that the general practitioner, as represented by the family physician and family dentist, has been instrumental in bringing greater comfort to the human family than any other class of professional man, and this is said with a full realization of the marvelous advances made in the management of disease by specialists. This is not the place to discuss in detail this matter of specialization, but it may be said in passing that there is no more danger of overspecializing in full denture work than in any other. It is a matter that will eventually be regulated by the inexorable law of supply and demand. Dr. Owen has referred to "an undercurrent of dissatisfaction in the profession with the progress that has been made in this work." No one questions the sincerity of purpose of the men most prominent in full denture construction, but there has been an unquestioned disappointment on the part of the profession in the apparent lack of standardization of this work by the leaders in this specialty. At least, it has seemed that there was such a lack of agreement that it has been confusing. Possibly this is more apparent than real, and also possibly if it is real, it is unavoidable. It may be that standardization is peculiarly difficult in this specialty, and yet standardization has been achieved to a greater degree in other departments of our work, in operative dentistry, for instance. In this, there is no disposition for the pot to call the kettle black, but this at least may be said that if a tooth needs to be

filled, there is a clearer conception on the part of the rank and file as to how it should be done than there is as to the most acceptable means of inserting a full denture. And there is a conviction on the part of many that it might be possible for our leaders in this work to get closer together than they are. We confidently hope that this may be consummated before very long to the complete satisfaction of all. Dr. Owen has raised the question as to the relation of the National Society of Denture Prosthetists to these various considerations. I am not sufficiently familiar with the work of this organization to make any pertinent comment except this: I know so many of these men personally that I have unbounded confidence in their earnestness and their ability, and I have not the slightest doubt of their ultimate solution of all their problems. If there has been some heated discussion, as Dr. Owen has intimated, it is only because men of real conviction cannot be expected to arrive at a common basis of agreement, and cannot make real progress without a frank ventilation of their varying opinions. Sometimes, an apparent disagreement is only an earnest effort to find the truth, and we must not make too big a bug-a-boo of a little honest controversy. I have nothing but the best of wishes for this society, and I trust that it will continue to function with unabated vigor. I would consider it a real detriment to dentistry if it should ever become inactive. We need all the organized effort that we can have in dentistry to make it advance as it should, and it is the most natural thing in the world for men who are interested in the same line of effort to get together with a common purpose and study the problems that confront them in their daily work. There is little danger that there will be too many societies in the dental profession as long as every society has a real mission and is doing a real work, and these requirements seem to be amply met by the National Society of Denture Prosthetists.

THE PULPLESS TOOTH, ITS PATHOLOGY AND CONSERVATION; A NEW METHOD AND TECHNIC OF FILLING ROOT CANALS*

By J. P. BUCKLEY, PH.G., D.D.S., F.A.C.D., Hollywood, Calif.

IT might appear on first thought that reading a paper on the pulpless tooth before the Section on Partial Denture Prosthesis was inappropriate; but to those who have read and studied the published proceedings of the Section for the past few years, and thereby learned the breadth of your vision in the construction of your restorations, no subject it would seem to me is of greater significance. Therefore, I am happy to discuss with you men the pulpless tooth, its pathology and conservation, which includes the treatment of the case and the filling of the root canal.

In an article read before the American Dental Association in Dallas, Texas, in 1924, I discussed in detail the subject of bone, its pathology and regeneration. Other writers in recent years have also discussed bone from various points of view; and, while this phase of my subject is of prime importance, I need only at this time to review briefly what has been published before.

A microscopic study of the structure of bone shows that the framework is composed of lamellae, or strands of con-

*Read before the Section on Partial Denture Prosthesis at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 21, 1928.

nective tissue in a calcified ground substance in which is lodged the marrow; while scattered through the substance of the lamellae are flat, oval spaces, the lacunae, containing the bone corpuscles, which send branches into the surrounding bone through the capillary channels called canaliculi. In endochondral bone, large, tubelike structures, the haversian canals, channel the bone throughout and afford passage to the blood vessels. These are most numerous in compact bone. Each canal contains an artery and a vein, with protective covering of connective tissue, which contains lymphatic vessels and endosteal cells. Canals, similar to the haversian, pierce the surface in a vertical direction and carry blood vessels from the periosteum to the interior of the bone. These are called Volkmann's canals.

The developed periosteum is a tough fibrovascular sheathing intimately applied to the bone surface. Its outer fibrous layer carries the periosteal blood vessels, while the inner layer is composed of cellular osteogenic tissue, endowed with active bone-forming properties. The periosteum performs two important functions: By virtue of its blood and lymph supply, it carries nutrition to the underlying bone, and by its osteogenic cells, it increases the thickness of the bone. The manner of attachment of the periosteum to the bone is of the greatest pathologic significance. The periosteum is continuous over the entire surface of all bones, except the portion of articulating surfaces covered by intervening cartilage. All such bones have a periosteum of their own; while bones that are united by sutures are covered by a common periosteum. While the periosteum covers the bone closely in all places, it is well to remember that it is not uniformly attached; it is only held in contact by the lightest of areolar tissues, except in the following positions: at the margin of the cartilage around the articulating ends of the bones; where it approaches the origin of muscles, insertion of tendons or ligaments and immediately beneath such attachments, and where the skin or mucous membrane seems attached to the underlying bone, as around the auditory meatus, the gums and mucous membrane of the nose. In all such positions, the periosteum is firmly attached to the bone. In fact, as stated by Noyes, here it becomes a part of the bone, and, through this medium, the connections between the muscles, fascia, etc., and the framework of the skeleton is accomplished.

It should be unnecessary with an audience of dentists to discuss in detail the anatomy and histology of the more purely dental tissues. Bone and its associated structures have been thus considered somewhat in detail because our broader field in dentistry today includes these structures. In this connection, we should remember that the pericementum, which covers the cementum of the tooth and fills the space between the surface of the root and the bony wall of the alveolus, is a fibrous membrane, well supplied with blood vessels and nerves, and bears a close relation to the periosteum in the attached portion, yet differing from it in certain essential respects. The pericementum is not a continuation of the periosteum down into the alveolus, the hole occupied by the tooth root. The latter stops at the border of the alveolus, where it unites with the pericementum around its circumference. At no surface on the cementum is the pericementum but lightly attached as is the case of the periosteum on many surfaces of the bone. In the pathology and thera-

peutics of the pulpless tooth, this is an important consideration.

The sievelike plates of compact bone forming the alveolar process and to which the pericementum is also attached by the principal fibers, as named by Black, are called the cribriform plates or lamina dura; and, according to Noyes,[1] they are really made up of a thin layer of subpericemental bone, which has been built onto the plates of cancellous bone. This writer well emphasizes the fact that whenever the pericementum is separated from its attachment to the cementum, as in a pyorrheal pocket, it can only be reattached by placing and keeping the tissues in physiologic contact long enough for a new lamella of cementum to be deposited into which the principal fibers extend and become calcified. This, while true, is no justification for the radical surgery that is frequently carried out for the correction of pyorrheal conditions.

With this groundwork, we will now consider the pathology of the tissues and briefly the therapeutics indicated after the death and decomposition of the dental pulp and the involvement of the periapical structures. In the early days, when some of you and I were in college, the treatment of pulpless teeth and their sequelae was purely empiric. The reason for this, as I discovered early in my professional career, was the apparent lack of interest in the pathology of the dead pulp and its chemical decomposition. A knowledge of the changes wrought in the splitting up of the complex bodies of the dental pulp by bacteria is of the greatest significance, pathologically and therapeutically considered. The only method by which drugs and remedies can be scientifically and rationally applied to the treatment of the conditions under consideration is to have a definite knowledge of the intermediate and end products resulting from the putrefactive process. This has been elsewhere discussed by myself and others and need not be repeated here, but its importance must ever be remembered; and we should also keep definitely in mind the now known and recognized fact that the toxins resulting from pulp decomposition, as well as the bacteria which inaugurate and carry on the process, if by instrumentation or otherwise, are carried into the surrounding tissues and are capable of producing inflammation and suppuration. This, then, results in a focus of infection about which we have heard so much in recent years.

A focus of infection is any circumscribed area of tissue which is successfully inoculated with pathogenic bacteria. Infectious foci may be one of two kinds: primary, when they are usually found in tissues communicating with mucous membranes or cutaneous surfaces, or with a gangrenous canal of a pulpless tooth; or, secondary, when found in adjacent or distant structures as a result of hematogenous or lymphogenous dissimilation. It is essential here that we differentiate between the mere presence of germs and an infection. The significance of the presence of bacteria in any tissue of the body must depend on whether or not a diseased condition or infection exists. Infection is the successful invasion of a tissue by bacteria, with cellular change and inflammatory reaction. In other words, infection means an abnormal condition resulting from the deleterious action of the bacteria on the host. Strictly speaking, then, a pulpless tooth as such cannot be infected. It may harbor or be infested with bacteria, but

1. Noyes, F. B.: Dental Histology and Embryology, Philadelphia, Lea & Febiger, 1912.

not infected. I am not speaking of or including dental caries here. The germs can neither successfully invade the tissue or tooth structure, nor can they cause cellular change and inflammatory reaction in this tissue. Pulpless teeth with open foramina infested with or harboring bacteria can, and generally do, cause infection of the periapical tissues. Let us get clearly in our minds that the presence of bacteria and an infection are not synonymous. Organisms may, of course, find entrance to any tissue or organ of the body, but unless they grow, multiply and produce some deleterious action on the host, their presence is without any special significance. Hartzell says:[2] "Streptococci may be found on every surface of the mucous membrane from the mouth to the anus." While this is true, as you well know, we need not necessarily have a streptococcic infection.

This brings us then to a discussion of pathology. An infection of the periapical tissues always involves the bony structures. The extent of the involvement depends on several factors: the character and virulence of the invading germ, and the amount and character of toxins escaping from the gangrenous canal, the source of the infection; as well as the immunity or lack of immunity of the individual. Nearly all investigators have found different organisms involved in these infections; but practically are all agreed that the streptococci, of which there are many types and strains, predominate. The pathologic process which is started in the tissue at and immediately surrounding the foramina spreads to the cancellated structure of the jaw through one or more of the numerous openings in the lamina dura. This results in an osteomyelitis, and the lamina dura soon breaks down. The destruction of bone in an infectious inflammation is now known to be caused by a combined action of osteoclasts and leukocytes. Frequently, in this condition, we find roentgenographic evidence of a condensing osteitis or, more properly, bone sclerosis, which is a healthy sign; for this is Nature's method of warding off, limiting and controlling infection in bone.

In his discussion of this subject, Hatton emphasizes the fact that inflammation does three things to bone. He says:[3] "It either kills it, and we have dead bone or necrosis; or it causes absorption, and we have an area of rarefaction; or it stimulates bone formation, and we have hyperplasia and hypercementosis." When an infection involves bone from without, as in the arm or leg, where it first breaks down the overlying soft tissue and thence passes through the periosteum to the compact bone, it is more likely to cause necrosis. In these cases, the pus can readily strip the periosteum from its light areolar attachment to the bone, thereby shutting off the circulation; which results in dead bone with the ultimate formation of a sequestrum. When the infection comes from within, as in a gangrenous canal of a pulpless tooth, and involves at once the cancellous structure of the bone, we generally have an area of rarefaction. Overfilling of a root, especially with a foreign material such as guttapercha, even though the operation is aseptically performed, is likely to act as an irritant which stimulates bone formation, resulting in hyperplasia and hypercementosis.

2. Hartzell, T. B.: Review of the Literature Regarding Infected Teeth, J.A.D.A., 13: 441 (April) 1896.

3. Hatton, E. H.: Disc. of Buckley, J. P.: Bone in Relation to the Treatment of Pulpless Teeth, J.A.D.A., 12: 309 (March) 1925.

This may produce trophic disturbances such as neuralgia and a possible neuritis, and may also cause a neoplasm, which may or may not be disclosed in the roentgenogram. To quote Hatton again on the mode of infection in the periapical region:[3]

> It seems to me that few histologists or pathologists, and fewer clinicians, have grasped the full significance of the arrangement of the lymph channels in the periapical region as demonstrated by Noyes and Dewey. One could predict with certainty on the basis of distribution alone that infection must pass out through the center of the apical foramen within the perivascular lymphatics into the periapical space and thence in the canals of the bone. In other words, infection here, as frequently elsewhere in the body, is a lymphangitis, and follows the lymph passages. These pass out through the foramina in the center of the pulp canal and not adjacent to the walls, but accompanying the vessels, and thence into the bone or into collaterals that run out into the periodontal membrane; so that the infection spares for a time the apex, the cementum at the apex and the attached periodontal membrane.

These statements by Hatton, a medical man doing nothing but dental research work, are full of hope and confidence for those willing to undertake root canal work and do it well; and it is a significant fact that in places such as Illinois and Michigan, where most of the research work on this problem is under way, the profession is taking a renewed interest in root canal work, and medical men are leaving the problem to the dentist as to the best means of eliminating infectious foci in the mouth. When the medical man suspects or discovers areas of infection in the mouth, it is his plain duty to refer the patient to the family dentist, with instructions, or a demand if necessary, that such infection be removed. How the infection should be eliminated should be left wholly to the dentist. In many cases, it is not necessary to wreck a mouth with this in mind.

To Frank Billings of Chicago, in large measure, is due the credit for directing the attention of both medicine and dentistry to the dire results of focal infection in the mouth. For years, I practiced in Chicago, and many of the patients from the office of Dr. Billings were also patients of mine. Just before writing this paper, I wrote Dr. Billings asking his present position on this subject. In his reply, he said:

> The fundamental principles of focal infection which include infections about the mouth, including the teeth, have been thoroughly established. There is no question of the importance of focal infection in relation to systemic disease and especially to chronic constitutional disorders. Like every other established principle in medicine, focal infection has been abused in practice. By this, I mean that, in many instances, patients have been subjected to the sacrifice of needless operations in the removal of teeth and of tonsils, and many other unwarranted operations. Often, the real primary focus has been undetected, and yet the patient subjected to operations for removal of alleged focal infection elsewhere in the body. Existing focal infection may be due to general physical disability and lack of resistance, a condition often interpreted as due to the existing focal infection. In the practice of dentistry, I have always maintained that the dentist should be qualified to judge whether existing infection about the teeth requires removal of teeth or other treatment. So, too, the dentist should be the judge of the character of treatment needed in the form of fillings, crowns, bridgework, etc. I think I have made clear my position in regard to focal infection and particularly concerning mouth infection.

One fact in relation to bone and its regeneration which has been wholly ignored or entirely overlooked in the past by those who have ruthlessly and, may I say, thoughtlessly condemned all pulpless teeth has been repeatedly mentioned by Noyes[1] and others: Bone, while

physically hard and rigid, is a plastic tissue and is continually being built and rebuilt as long as it functions as an organ of support. We should never forget in this connection that bone is not a solid, unchanging tissue, but should rather think of it as a structure containing millions of active tissue-forming cells, each ever ready to respond to mechanical or other stimuli, thus continually building, tearing down and rebuilding its substance. Let us remember also here that many investigators have observed that resected roots of teeth have been subsequently covered over with dense fibrous tissue which apparently protects them from reinfection. Under favorable conditions, this tissue should be gradually replaced by bone.

For twenty-five years or more, three rather general methods of treatment for dead and gangrenous pulps conditions have been more or less closely followed by the profession: the sodium-potassium-ionization method of Rhein; the sulphuric acid method of Callahan; and my own formocresol-phenolsulphonic acid method. About ten years ago, Howe introduced the silver reduction method. Each of us, especially the first three named, have practiced and taught our own technic. Because of its simplicity, lack of time required and results obtained, I still advocate and use formocresol for the initial treatment, followed by a thorough opening and cleansing of all canals with phenolsulphonic acid and broaches—the chemico-mechanical process, as I call it. The younger men in the profession have selected and used from the various methods in vogue that which seemed to meet the demands in their practice. Much credit, therefore, is due such men as Coolidge and Blayney of Chicago, Hall of Kansas City, Grove of St. Paul, Best of Minneapolis, Johnson of Atlanta and others, for from them we have learned that no one method needs be followed in detail for successful results.

The surgery of root canal treatment has been developed today to such a high degree that little else is needed along this line; but in my judgment there is much room for improvement in the materials used for filling the canals after the root and bone surgery. The urgency of the demand and the genius of our profession will surely solve this phase of the pulpless tooth problem. With this in mind for some years now, I, with others, have been endeavoring to supply this much needed improvement in our root canal work. Today I appear before you with a new method and technic for filling the canals of pulpless teeth, and since my return to the practice of certain special fields in dentistry, this method has given me more satisfaction than any other I have ever used. I am happy to present it to you for your earnest and critical consideration.

About four or five years ago, I developed a new material, called dentinoid, for protecting the dental pulp and filling the canals of pulpless teeth. This product served its purpose nicely for pulp protection, but for root canal work it lacked two essential properties: it was not plastic enough to be readily introduced into a canal and it was not sufficiently radiopaque for all practical purposes. In this connection, I will say that the radiopacity of a root canal filling material adds nothing to its value as such; but, in this day and age, we have been trained, and rightfully so, to look for something definite as a root filling in the roentgenogram, and if such

is not found, a good root canal operation may be condemned by both medical men and dentists. Because of this, I experimented further with the first product introduced, and within the past two years, I have succeeded in changing the formula slightly so that the newer product, called dentinoid-radiopacic, meets every requirement in both pulp protection and root canal work. The newer dentinoid, or dentinoid-radiopacic, is a purely physical mixture of calcium phosphate and barium sulphate, with such antiseptics as thymol, thymol iodid and orthoform, and with a sufficient amount of resin to act as a binder. It give plasticity to the mass when the powder is mixed with alcohol or chloroform. When thus mixed, it gradually hardens into a compact solid. Dentinoid is a medicated, artificial dentin, a nonconductor, absolutely nonirritating, and, while I hesitate to use the expression, it is as nearly permanently antiseptic as a material of this kind can possibly be. The antiseptics used are insoluble in water; the thymol and orthoform are both soluble in alcohol, which is generally used; thymol and thymol iodid are soluble in chloroform, and all are stimulating in character, and when the product is used for pulp protection in deep-seated cavities, it not only sterilizes the dentin immediately over the pulp, but encourages the deposition of secondary dentin by stimulating the odontoblastic layer of cells, thereby enlisting Nature's protection. When the product is used for filling root canals, it likewise keeps the canal and dentin sterile and tends also to stimulate the cementoblasts which, it is believed, in time, will completely cover over the foramina as the subsequent lamellae of the cementum are formed, when again we have Nature's protection. Subsequent roentgenographic interpretation seems to substantiate this view.

In this paper, I shall not discuss the indications or contraindications for saving a pulpless tooth; nor will I discuss further than I have the therapeutics or surgery involved in preparing a canal for the final filling; though in passing I should emphasize the importance of this phase of the work, for we should never attempt to fill any canal that has not been explored and properly opened. While the lead point used in the technic I shall describe is far stiffer and more rigid than a guttapercha point, it is not expected to go to place in a canal which has not been properly prepared for filling. This point cannot be emphasized too strongly. Unless we are willing to spend the time to do this work well, it should not be undertaken at all. Carelessness in this regard is what has caused the difficulty in the past. It requires no more skill to do this work properly than is necessary for almost every other operation that we are called on to perform.

I shall now describe in detail the mixing of dentinoid for use and the technic of filling the canals by the new method. There are only a few precautions to be observed in mixing the powder and liquid. A long series of experiments have shown that, for satisfactory results, the binder must be present in the powder in a certain and definite proportion; and, in the mixing process, it should be remembered that alcohol and chloroform freely dissolve both the binding substance (resin) and antiseptics. These liquids are thin in character and flow easily, and if care is not taken in making the mix, a certain amount of the binder and antiseptics will be removed by the selected liquid flowing through the powder and spread-

ing over the slab; which alters the properties of the product and changes the formula to this extent. This must be avoided. In mixing, therefore, place the desired amount of powder on the slab and make a concavity in the center into which the liquid may be added by drops from a small glass medicine dropper, incorporating the powder as the liquid is thus added. It is not necessary to spatulate the mix more than just enough to obtain the desired consistency for convenient handling and to bring the varnish, formed by the binder dissolving in the liquid, in contact with the insoluble particles or bulk of the powder (calcium phosphate and barium sulphate). More powder or liquid may be added, if necessary, to accomplish this end without danger of destroying the virtue of the product when set. The mix sets very slowly, and because of this property and its other physical characteristics, there is no need for haste when using the material for any purpose. Keep in mind that dentinoid is a purely physical mixture, before and after mixing; it is not a chemical compound or a dental cement.

In filling the canals of pulpless teeth, alcohol should always be the liquid used for making the mix, which should be quite plastic. It is presumed that alcohol is the liquid last used in the canal for removing the surface moisture, which is all that is necessary when this method is followed. Some of the alcohol thus used is purposely left in the canal, for better results are obtained when the canal is slightly moistened with this liquid. With a suitable instrument, the plastic dentinoid is carried to the mouth of the canal and gently worked to the apical end, filling the canal full, care being taken that all air has been displaced. Now, a lead point, which approximates the size of the canal, having been previously selected and tried in, and which, if desired, may also be used as a measuring or so-called "diagnostic" wire, is coated with the mixed dentinoid on the slab, and gently but firmly placed in the canal as far as it will go. The point acts as a piston or plunger and, if properly selected, will nearly reach the apical end, forcing the plastic material into such multiple foramina and lateral openings as may be present and opened, and thus filling all space not occupied by the lead itself. In first fitting it, the lead point should be marked and cut off about 3 mm. above the mouth of the canal and this portion flattened with a pair of pliers. It should then be kept in an alcohol bath for final sterilization until ready to be coated with the dentinoid and placed in the canal. The flattened end facilitates handling and also permits the projecting portion being easily bent against the floor of the pulp chamber. More plastic dentinoid is now placed over the point and pressure made with a small roll of cotton or bibulous paper. When it is known in advance that a post or dowel is to be subsequently fitted in the canal for some necessary restoration, the lead point should be shortened accordingly and only the apical third filled.

If for any reason the operator should prefer to use guttapercha points, ivory or other material instead of lead, they may be used in practically the same way, except, with guttapercha, the selected point or points may be dipped in euchapercha compound, eucalyptol compound or chloroform instead of alcohol just before being coated with the plastic dentinoid and placed in the canal. After being thus placed, heat may be applied and the cones firmly packed.

In clean cases, as in pulp removal with no periapical involvement, or where no opening has been made by pathologic process or overinstrumentation, it is best to have the point stop just short of the end, with dentinoid beyond. But where there is an opening of any size, however made, the lead point should fit the opening; and with this in mind in preparing the canal for the reception of the point, it should be left as it is, tapered or choke-bored. Thus, when the point is finally introduced, it will close the opening or stop where desired with none of the plastic dentinoid forced into the apical area. As intimated here, Nature has left all completely formed canals tapered or choke-bored, and in our root canal surgery, we should be careful not to remove or destroy this natural aid in our work. It would almost seem that Nature, in her wisdom, anticipated the progress of civilization and its concomitant tooth decay and pulp involvement, and made this wise provision.

Many dentists today are using both infiltration and conduction anesthesia, as indicated, for the painless removal of the dental pulp. In all such cases, where asepsis has been observed in the operation, immediate root filling with dentinoid and lead is especially indicated and advised, and the filling should stop at the dentino-cemental junction. If all details are carried out, absolutely no soreness follows. In cases in which the canal is so small that a lead point cannot be used to advantage in combination with dentinoid, the entire canal may be filled with the latter material alone, with every confidence of success; and with the new product, the root filling will be definitely radiopacic. If it can be done, the canal had better be enlarged nearly to the end so as to admit the selected point. Should dentinoid be used alone, it should be packed as directed for filling the canals of deciduous teeth.

Dentinoid is the ideal material for filling the canals of deciduous teeth. In these cases, the entire canal may be filled with the material alone, which should be placed to the end and compressed firmly with bibulous paper or a small cotton roll. When the canal is thus filled, it should be covered at once with zinc oxychlorid cement and the cavity in the tooth filled at this or a subsequent sitting.

CONCLUSIONS

The practice of dentistry today requires that every effort be made to save the tooth pulp and keep it in a healthy condition. For safety and protection, dentinoid should be placed in every deep-seated cavity immediately over the pulp; thus, practically replacing the same material as has been destroyed by the carious process. This certainly is better than the placing of some questionable foreign material, especially when it is remembered that the artificial dentin contains stimulating antiseptics.

Dentinoid adheres firmly to every surface of the tooth structure with which it comes in contact; but should it become necessary for any reason to soften the material in a cavity or canal of a tooth, it can be done by simply adding the liquid used in making the mix. This is a distinct advantage which a purely physical mixture has over a chemical combination.

In using dentinoid for filling the canals of pulpless teeth, it should be remembered that the material will become stiff as soon as the liquid is permitted to evaporate, but it requires a few days before the product sets or

hardens into a compact solid. In cases in which the root filling need not be disturbed for a post or dowel in some contemplated reconstruction work, it makes no difference about the delayed setting of the dentinoid, as long as it is known that it will ultimately set without shrinkage under the conditions and become extremely hard and resistant. When it is desired to use a post before the dentinoid sets firmly, only the apical half or third of the canal need be filled, and this covered with zinc oxychlorid or other quick setting cement.

The several advantages of the combination of dentinoid and lead for filling the canals of pulpless teeth must be obvious. By this method, the dentin need not be entirely free of moisture; the removal of the surface moisture is all that is necessary. Some of the alcohol used for removing the surface moisture is purposely left in the canal, which in itself is an advantage. Then, too, alcohol has a great affinity for water, and the liquids mix in all proportions. This is an advantage in that the alcohol used in making the mix with dentinoid holds in solution the binder and the thymol which are carried into the tubuli when the plastic material is placed in the canal. Thus, the tubules are sealed with an antiseptic therein contained, and the foramina and any possible lateral openings are sealed with dentinoid, a hard, firmly adherent, medicated, artificial dentin, which aids rather than hinders Nature in the healing process. Callahan, Groves, Puterbaugh, Blayney and others have stressed the importance of sealing the tubuli with a varnish or resin solution. In this relation, Blayney says[4]:

> The object of filling a root-canal is to maintain a healthy periapical tissue. As it is impossible to sterilize the entire tubular mass of the dentin, the inner ends of the tubules must be hermetically sealed in order to prevent infection or reinfection of the periapical tissue. This does not mean that one can be careless and fill the canals for half their length, because, in so doing, the dentinal tubules are not sealed, which permits reinfection.

An alcohol-resin solution will enter the tubuli, even though moist, and thus seal the pulpal openings. A chloroform-resin solution will not enter a moist tubuli for the simple fact that chloroform and water are physically incompatible. For this reason alcohol is used in making the mix with dentinoid for root canal work.

The advantage of using lead points and dentinoid in canals with large apical openings need not be emphasized; and the ease and certainty with which all canals can be perfectly filled to the end, and there only, by this method gives one a satisfaction not heretofore experienced. The recently published statistics of Blayney[5] emphasize again the importance of a technic which is certain and definite. With guttapercha and the solvents necessary to be used by the former methods in vogue, more or less guesswork was encountered even by our most careful operators. With the technic herewith presented, this guesswork is entirely eliminated, and the results in every case, if the canal is properly prepared for filling, are positive and certain. This cannot be said of any other method with which I am familiar.

If I can read correctly the signs of the times and properly interpret the literature of medicine and dentistry, both

4. Blayney, J. R.: Same Factors in Root Canal Treatment, J.AD.A., 11: 840-850 (Sept.) 1924.

5. Blayney, J. R.: Bull. Chicago Dental Society, Feb. 24, 1928.

professions today are admitting the overenthusiasm of some of their members in the recent past. Many physicians themselves have fallen victims to the craze of focal infection in the mouth, and are demanding caution with their patients. Dentistry is on the alert—everywhere men are investigating and studying the problem as never before; and it is a significant fact that in places such as Illinois and Michigan, where the best research work on this problem is under way, more and more conservatism is evidenced by the profession in relation to the pulpless tooth. All this leads to but one conclusion: The dentist of tomorrow who is not devoting all of his time to special practice must either learn how to treat the pulpless tooth correctly or turn this part of his work over to those who will do it right. In making these statements, let it be understood that I am not advocating the treatment and retention in the jaw of all pulpless teeth regardless of how badly diseased, or without due consideration of the patient's general health. If there is a systemic involvement, I am willing to go to any lengths with the physician in the extraction of questionable and suspected teeth; but the unfounded, inexcusable radicalism of the past, under which thousands of innocent teeth have been sacrificed on the altar of ignorance and hysteria, needlessly wrecking the masticatory apparatus of patients by the hundreds, must cease. No where in dental practice is there greater need for the use of those two essential remedies, of which I have spoken so frequently in the past: tincture of good judgment and fluid extract of common sense.

DISCUSSION

Elmer S. Best, Minneapolis, Minn.: Dr. Buckley speaks primarily of the histology of the parts under discussion. He has tactfully arranged his plans of presentation in order that you may refresh your memory histologically, thereby being in a better position to understand his attitude as he reveals to you his observations and conclusions concerning pulpless teeth. Bear in mind, if you please, that our essayist speaks to us on a most vital subject, not from the standpoint of a research worker, but from the standpoint of the clinician who, as a pioneer in this work, has many followers who carry out his idea of therapeutics in root canal work. He strikes at the most vital part of this problem when he says, "It is essential here that we differentiate between the mere presence of germs and an infection. The significance of the presence of bacteria in any tissue of the body must depend on whether or not a diseased condition or infection exists. Infection is the successful invasion of a tissue by bacteria, with cellular change and inflammatory reaction. In other words, infection means an abnormal condition resulting from the deleterious action of the bacteria on the host. Strictly speaking, then, a pulpless tooth as such cannot be infected. It may harbor or be infested with bacteria, but not infected. I am not speaking of or including dental caries here. The germs can neither successfully invade the tissue, tooth structure, nor can they cause cellular change and inflammatory reaction in this tissue. Pulpless teeth with open foramina infested with or harboring bacteria can and generally do cause infection of the periapical tissues. Let us get clear in our minds that the presence of bacteria and an infection are not synonymous. Organisms may, of course, find entrance to any tissue or organ of the body, but unless they grow, multiply and produce some deleterious action on the host, their presence is without any special significance." To the real scientist who has developed the theory of focal infection, we cannot give too much praise. It has meant much for us to have brought vividly to our attention the effect on our bodies of mouth infection. However, as is generally the case, a new wave of enthusiasm acting as the motive power of a new idea is apt to carry us away beyond the practical. This is not to be wondered at. It is oft repeated history in dentistry as in all other branches of human endeavor. Sooner or later, we discover the error we have made and get back

on solid foundation. Because the adoption of the theory of focal infection may interfere with certain things we may do and certain ideas we may have, we should not combat it. By the same token, neither should we adopt it *in toto* simply because it makes work easier for us. Dr. Buckley says, "It is essential here that we differentiate between the mere presence of germs and an infection." If you forget everything else that you may learn at this session of the American Dental Association, you will be well repaid for remembering this thought. I should say there is the greatest difference between the presence of germs and an infection, and yet, owing to the fact that streptococci have been found in culturing pulpless teeth, probably hundreds of thousands of teeth that could have been saved have been extracted. The presence of bacteria of all kinds in and around teeth of all description can be demonstrated by the microscope. The activity of such bacteria is made known by the roentgenogram and by clinical observation. What a shock it must have been to those who have been in the habit of removing pulpless teeth because of the revelation of the presence of pathologic bacteria in and around such teeth when they read McDonough's article in the *Journal of Dental Research* in which he duplicated such bacteriologic findings in his work on vital pulps in teeth with cavities. It naturally would be a shock for, if it was the correct thing to remove pulpless teeth because of the presence of pathologic bacteria, so must they remove all teeth with cavities. We have reached a crisis, and it is only common sense that lies latent, if not always active in the mind of every dentist, that will save us from being the targets of unlimited ridicule on account of the errors that have apparently been made in recent years. Do not misunderstand me. I insist most emphatically on the elimination of infection, but I happen to know, and have known for some time, that I cannot get rid of all bacteria in the mouth or anywhere else. Neither can you; so why worry about it? The able presentation by Dr. Buckley of this phase of the work is a knockout blow to some of the wild theories that have more than run their course. The length of the paper prevented Dr. Buckley from dealing at length with the saving of pulps of teeth with large cavities. I would like to touch on this for a few minutes because I feel it has a big part in the practice of every dentist in general practice. We have many patients who come to us with cavities so large that it looks as though pulp removal was necessary. This has caused us much concern in the past. There is a unanimity of opinion that the safest possible type of teeth are those with vital pulps and healthy supporting tissues. Hence, I have ceased to give any more time or thought to the never-ceasing arguments, pro and con, regarding the status quo of pulpless teeth; and for some time past, I have concentrated on an operation for saving vital pulps, when the vitality of such pulps is threatened. It is my conclusion, based on the most concentrated efforts of which I am capable, that the removal of a vital pulp is a distinct calamity and must be an admission of defeat on the part of the operator. At the very best, it is fraught with the gravest danger. There can be no argument about it. Some years ago, I became impressed with the fact that the solution of the question lay primarily in a refinement of our diagnosis, just as much as in the perfecting of a root canal operation. While the latter offered a big field for development, owing to the conditions continually revealed by the roentgen ray, it was apparent that some means must be employed to solve the problem of teeth having extensive caries in some way other than by pulp removal. This was revealed when after an extensive study of a large number of cases, it was found that the great majority of teeth had lost their pulps, owing to the presence of deep-seated caries. Experience had taught dentists that it was highly unsatisfactory to place fillings in such teeth, as pulpitis frequently followed, which necessitates the removal of the pulps. Hence, the pulps were removed before the fillings were placed. Two avenues were open at that time as a solution of the problem of the disposition of the dental pulp in the case of deep-seated caries. They were: pulp-capping as a cure, and oral prophylaxis as a prevention. A review of the literature on pulp-capping gave but slight encouragement, as it was found that the majority of writers had but slight confidence in it. Volumes have been written on the prevention of caries, and while considerable progress may have been made, as far as the general

public is concerned, it is going to take a long time to so educate the people that those who seek the services of their dentist will do so before caries has advanced to the point where the pulp is threatened, if not actually involved. A deep study of the subject, therefore, leaves the conviction that some means other than that commonly employed must be developed to handle the situation. Roentgenographic study of teeth with caries revealed a big effort on the part of nature to combat the advancing disease processes by laying down secondary dentin in varying degrees of thickness. In view of the fact that secondary dentin is present in the teeth of most adults, its formation does not seem to have any particularly deleterious effects from the standpoint of the pathosis involved. I have long been convinced that one of the causes of root filling failure has been a lack of thoroughness and a lack of asepsis. Was it not possible that the same factors existed where attempts have been made to save pulps in a vital condition in those teeth in which extensive caries existed? A series of cases were run through for observation and the results checked carefully. Only those cases were selected in which ordinarily the pulp would have been removed, or the tooth extracted, owing to the extent of the caries. The vitality of the pulp having been determined, the rubber dam was applied and the overhanging enamel chipped away. With curets, the carious dentin was cautiously removed. Owing to previous unsatisfactory experiences in pulp-capping, precautions were taken at all times to prevent exposure of the pulp if at all possible. At first, the value of this precaution was not demonstrated, but I am now convinced that it is one of the most important steps in the operation. After the removal of all of the carious dentin from the side walls of the cavity, the pulpal and axial walls are attacked. With good vision and access, this dentin is cautiously removed and the cavity is well cleansed, but the pulp is not exposed, even though a layer of involved dentin is all that prevents its exposure. It is thoroughly irrigated with warmed surgical solution of chlorinated soda (Dakin's). This mopping or sponging process should be kept up for from ten to fifteen minutes. The cavity is then dried and one drop of a mixture of zinc, magnesia, silver nitrate powder and eugenol, of fairly thick consistency, is placed in the base of the cavity with a fine probe. With a small, dry pellet of cotton, this mixture is gently spread over the floor. Excavators are now used to trim the excess away from the margins. Particular attention must be paid to its removal from the gingival margin. While the material contains silver nitrate, if due precaution is taken to keep it away from the margins no discolorations will be apparent. The next step is to cover the above mentioned mixture with oxychlorid of zinc cement. Oxychlorid is used for the reason that it is one of the few cements through which moisture will not pass. After the oxychlorid of zinc is put in place, the cavity is filled with oxyphosphate cement and the occlusion is tested with carbon paper and relieved if necessary. The tooth is given a period of rest. If no symptoms contraindicate the procedure, the permanent restoration is put in place in a few weeks. This operation does not lend itself to a careless or indifferent technic, but must be carried out with the closest attention to detail. The results observed in the series of cases referred to were astounding. Pulps for which but little hope could be held out were found to retain their vitality and an absence of unfavorable symptoms, together with encouraging roentegenographic evidence, seemed to indicate success. Further observations justified a feeling of optimism, and after considerable time, the operation was adopted as practical. It is here offered as a contribution to modern preventive dentistry. Concerning Dr. Buckley's method of filling the canals with metal points, he is right. I have for some time been working along somewhat different lines with the same object in mind, and I am convinced this idea is basically sound.

Edouard M. Hall, Kansas City, Mo.: Dr. Buckley, in his opening paragraph, speaks of what "might appear or seem to be the inappropriateness" of his paper being read before this section. It is my belief that partial dentures, scientifically designed and constructed to replace missing teeth in such manner as best to preserve and protect the remaining teeth and supporting tissues, will do more to lessen, by prevention, the pulpless tooth problem than any other single line of dental service, with the possible exception of prophylaxis. I say this because I believe that cutting into good teeth for extensive

inlays, onlays, three-quarter veneers, etc., for purposes of attachment for fixed or removable bridges or other appliances is too often the beginning of changes which result in ultimate death of the pulps in those teeth. I most heartily compliment the purpose and work of this section because I believe your investigations and developments hold great possibilities for service to suffering humanity. It is a well established fact, though not so extensively recognized as it should be, that in planning a partial denture restoration (or, for that matter, any other restoration), the condition of health or disease of underlying bone and supporting structures should be determined as far as possible by good roentgenograms and every other means at our command. Therefore, Dr. Buckley's discussion of bone, its structure, pathology, regeneration, etc., seems extremely pertinent to me and I would encourage and advise each of you to study the writings of Noyes, Hatton, MacMillan and others on the right interpretation of changes which take place in bone: whether they are defensive (therefore physiologic), pathologic or the result of "disuse atrophy," etc. Dr. MacMillan says, "For every change of external stress, there is a corresponding change of internal structure of bone." Thus, a knowledge, properly applied, of bone function and structure and changes associated therewith will do much to lessen the evils now connected with radical alveolotomy, the so-called surgical removal of teeth and meddlesome interference in conditions wrongfully diagnosed as "residual infection." Dr. Buckley calls attention to the fact that the "mere presence" of bacteria is not "proof of infection." Because this is true, it requires more than a positive growth in a culture tube to prove that an infection exists. Thus, the purely bacteriologic examination and test is not sufficient to determine whether or not a disease condition is present. Don't understand me as trying to discredit the bacteriologist: I am not; but I would warn you that infection can best be determined by a knowledge of normal function and structure of a given tissue or organ as compared with deviations from normal, the result of cellular changes and inflammatory reactions. This is based upon careful study, wide clinical experience and sane judgment. As Dr. Buckley says, the seriousness and extent of an infection is largely dependent upon, or influenced by, several factors, such as the susceptibility or immunity of the host, the quantity and virulence of the invading organisms and the presence of baleful toxins associated therewith. I realize that the words immunity and susceptibility are terms with which to conjure, but I believe that we, as yet, understand little of their full meaning and importance. I am convinced that biologic factors of vital resistance have infinitely more to do with the recovery of a diseased tissue than all of the therapeutic agents known to pharmacology put together. I do not want to be understood as taking a position of antiseptic nihilism, because I believe in rational therapeutics, but to me rational therapeutics means less and less use of heroic germicides with their lethal effect upon living tissue cells and more and more the application of aseptic surgical principles of removing the cause, draining, evacuating and ventilating the infected area and applying only such antiseptics as will inhibit the growth of bacteria without tissue damage. From an article, "Self-Disinfecting Power of the Nasal Mucosa,"[6] I quote as follows: "Gay has recently said that any one who has carefully followed the evolution of the science of immunology must feel certain that in many of the protective processes there is concerned some third, as yet not clearly understood, factor in addition to the mobile polymorphonuclear phagocytes of the blood stream and the antibodies." This article is exceedingly interesting to me and strengthens my belief in what I called attention to several years ago as the chemistry of living protoplasm and its relation to tissue immunity. I believe from close clinical observation that this third factor having to do with immunity is a problem of vital chemistry, and as such can only be studied clinically in terms of living tissue reactions. I believe apical and periapical conditions which call for root resection are such as to make improbable, if not impossible, the throwing down of a cementoid tissue over the root end because such a tooth is in an advanced state of cytoplasmic degeneration within the tubuli, and as far as I know, no one has ever found a specimen of a pulpless tooth with a cementoid deposit covering the resected root end. I have seen some wonderful specimens of cemental resorption and

6. Current Comment, J.A.M.A., 91: 100 (July 14) 1928.

repair, the work of Dr. Orban at Chicago College of Dental Surgery, but I believe none of them were associated with infected pulpless teeth. It must be apparent to those of you who have kept in touch with developments in the field of pulpless teeth that there is a general agreement among the leading authorities as to fundamental principles and requirements in root canal work, the differences being chiefly as to therapeutic agents and root filling materials and methods of accomplishing similar results. All are agreed that complete removal of pulp tissue and hermetic sealing of the canal without injury to vital apical and periapical tissues is the object of our efforts. I heartily agree with Dr. Buckley when he says, "We should never attempt to fill any canal that has not been explored and properly opened" and "Unless we are willing to spend the time to do this work well, it should not be undertaken at all. Carelessness in this regard is what has caused difficulty in the past." Dr. Hatton, in discussing histologic studies of pulpless teeth, says, "It is very clear that three types of incomplete treatment are common, namely: First, the canals are very superficially cleansed and much of the pulp tissue is not removed. It is probably true that all the pulp tissue cannot be removed until the shape, course and diameter of the canals are modified by filing or curetment. Yet the efforts of the operators to remove the pulps, as observed in treated teeth, are frequently pitifully inadequate. Second, the filling is not brought close to the apex. In other words, the canal is incompletely filled longitudinally. While this type of incomplete treatment may and should be criticized, yet in some instances it certainly is not as serious a matter as discrepancies in the first or last form of inadequate treatment, and furthermore, mistakes of this kind are easiest seen in the x-ray film. It is wise to believe that failure to bring the filling reasonably close to the apex does handicap a favorable outcome, because all of the statistics prove that restorations are more common about well-filled teeth, as determined by the x-ray. The third type of failure should be considered most serious of all; that is, when the diameter of the filling material is considerably less than the diameter of the pulp canal. It allows circulatory elements to pass between the filling and the wall of the canal by capillary attraction and diffusion and also permits the passage of bacteria and toxins from one part of the tooth to another. This cannot be recognized in the x-ray film and it is the most common of the three failures made by dentists in the treatment and filling of canals." Dr. Buckley speaks of "the sodium-potassium-ionization method of Rhein; the sulphuric acid method of Callahan; the silver-reduction method of Howe, and his own formocresol-phenolsulphonic acid method," and I agree with him that the advocates and users of these methods and many others can all show cases of successful results in root canal treatment. But it seems to me that this problem of the pulpless tooth will never be settled until several skilful, experienced operators, each following some chosen and definitely outlined therapeutic and technical procedure, are placed where they can do as many root canal operations as possible in the next ten years, keeping complete case records. Then the method which produces the highest percentage of successful results as proved by tabulated records would surely have much to recommend itself to the profession. In this connection, may I suggest that records of work done by dental students are indeed interesting and valuable but are not and cannot be of research caliber, because clinical experience and sound judgment are essential factors in root canal work. Dr. Buckley says that he still advocates and uses formocresol for the initial treatment. Here, I take it, he is speaking of the technic for opening into infective areas at the first visit of the patient. Then, he says, "This is followed by a thorough opening and cleansing of all canals with phenolsulphonic acid and broaches." This, I presume, at a subsequent visit. This procedure has been followed by most of us with variations only as to the therapeutic agent sealed in the pulp chamber at the first visit. For years, I did as Dr. Buckley, and sealed formocresol in the pulp chamber for twenty-four hours with the idea of reducing the virulence of the infectious matter in the canal and believing that any attempt made to enter the canal at the first sitting was liable to force infectious material through the foramen into periapical tissue. For the past several years, whether the periapical involvement is chronic or acute, we have attempted to remove all of the previous root fillings or other obstructions in the canals at the first visit. If the root filling or other canal content is porous

or permeable enough for any sterlizing agent to penetrate and thus make it "safer" to remove at a subsequent visit, we believe it is loose enough to be capable of being removed at the first visit without forcing septic or toxic débris through the root end, if our technic is correct. When the previous root filling is so dense that it cannot be easily removed at the first visit, it is too dense for any sterilizing agent to penetrate, and I am convinced that our attention should be given to the manner rather than the time of removing obstructions in pulp canals to see that we evacuate, retract and remove débris instead of forcing it through the root end. Our chief concern is to be able, a soon as possible, to remove the root canal contents, and thus to drain and ventilate periapical tissues and to bring the surgical solution of chlorinated soda and iodin solutions in contact with canal walls. Where this is accomplished without forcing septic débris through the root end, we have no fear of starting an active or acute inflammation. The only exceptions to this procedure in my practice are those acute cases in which the teeth are too sore to be worked on and the condition is such that by lancing, or otherwise draining, the acute soreness will subside and the teeth thereafter be less painful to operate. In describing his technic with dentinoid, Dr. Buckley says, "When filling the canals of pulpless teeth, alcohol should always be the liquid used for making the mix, which should be quite plastic." Again, he says, "In cases in which the canal is so small that a lead point cannot be used to advantage in combination with dentinoid, the entire canal may be filled with the latter material alone, with every confidence of success." And again, he says, "The lead point should be marked and cut off about 3 mm. above the mouth of the canal and this portion flattened with a pair of pliers. The flattened end facilitates handling and also permits the projecting portion being easily bent against the floor of the pulp chamber. More plastic dentinoid is now placed over the point and pressure made with a small roll of cotton or bibulous paper." This last, as explained in his clinic, is to be sure to force dentinoid in and around the lead point. In another place, he speaks of "forcing the plastic material into such multiple foramina and lateral openings as may be present and opened up, thus filling all space not occupied by the lead itself. Now all of these expressions indicate how plastic the mix of dentinoid should be made if these results are to be attained, and I agree with him that this is true, and that only a very plastic material, if a paste is used at all, can be successfully introduced into a root canal. And we all know that a plastic material lends itself more easily to a perfect adaptation to the walls of the canal. Quoting Dr. Buckley again: "It is presumed that alcohol is the liquid last used in the canal for removing the surface moisture, which is all that is necessary when this method is followed. Some of the alcohol thus used is purposely left in the canal, for better results are obtained when the canal is slightly moistened with alcohol." I agree with this statement also, because it does aid in inserting and placing the plastic dentinoid to the end of the canal. He then says, "With a suitable instrument, the plastic dentinoid is carried to the mouth of the canal and gently worked to the apical end, filling the canal full, and care is taken that all air has been displaced. Now, a lead point which approximates the size of the canal, having been previously selected and tried in, is coated with the mixed dentinoid on the slab and then gently but firmly placed in the canal as far as it will go." I ask Dr. Buckley to explain to me how he can take such a plastic material and work it into a canal with alcohol to make it still more plastic and then force in a lead point like "a piston or plunger" and keep the material from going through the root end into periapical tissues. In my opinion, the answer, in most cases, is that, during the mechanical preparation of the canal, the foramina have been blocked or plugged with tooth débris; which may easily happen. That dentinoid is an "ideal material for filling the canals of deciduous teeth," to me means that it will absorb about as fast as the tooth root resorbs, and if it absorbs in a deciduous tooth, it will do the same in a permanent tooth, and no matter how slowly, if at all, the root filling will ultimately fail. Dr. Buckley recommends immediate root filling in cases in which vital pulps are removed. I do not favor this practice because I cannot secure all the required guides such as the measurement control of instrumentation, the complete cessation of hemorrhage and the absence of traumatic pains or soreness, all of which I want after all preparation of the

canal is completed and before the filling is inserted. I never fill a canal before the third visit, and more often at the fourth visit of the patient. Having spoken as often as I have in almost every part of the country in regard to my disbelief in a medicated root canal filling material, it is impossible for me not to take exception to such terms as medicated artificial dentin, absolutely non-irritating and permanently antiseptic. These expressions with the following, "the ease and certainty with which all canals may be perfectly filled to the end, and there only," and "guesswork is entirely eliminated and results in every case are positive and certain," I believe will cause altogether too many dentists to believe that dentinoid is the panacea of all their root canal troubles, and they will not do the necessary and painstaking mechanical work which, in reality, is the crux of the whole pulpless tooth problem.

Dr. Buckley (closing): Dr. Hall has worked out what in my judgment is one of the best technics known for opening the canals of teeth preparatory to filling. So, you can clean the canal with his method and then fill it with mine. I am not going to argue on nonessential details. The things we are after in this day and age are fundamentals, and fundamentally Dr. Hall and I agree absolutely. Biologic influence does have more to do in controlling an infection than any drug. In many places, I am known as the drug man of dentistry, and time and again you have heard me say that if you expect any drug or remedy to cure any disease, you are expecting too much. All you can possibly expect is to use the drug or remedy in such a way that you will aid Nature in her effort to overcome and control disease. There are few specifics in medicine; there are fewer still in dentistry. I am glad that Dr. Best has seen fit to emphasize the point in my paper which I have discussed far more in detail in other papers than I felt at liberty to do in this, the significance of the presence of bacteria in the tissues of the body, trying to drive home as he did better than I could possibly do the fact that the presence of bacteria and an infection are not synonymous. Take any pathologist, any author of a book on pathology, and, in every instance, you will find that he calls attention to the fact that, when we have an infection, we must have cellular change and inflammatory reaction. I have told some of these radical men, so called hundred percenters, time and again, that I do not care if the tooth is removed surgically; I do not care if the entire area seemingly involved is curetted to beyond the so-called diseased tissue: we are not removing all the bacteria nor could we remove all the bacteria present if we began at the head and ended at the toe. Surgeons do not in this day and age attempt to remove all the bacteria. They remove that area that shows evidence of cellular change and inflammatory reaction. It should be the effort of every man to make a conscious effort to save every living pulp. Dr. Best was the first man tc outline for us a detailed and definite asepsis technic. Some of you who studied under me in school have heard me talk about asepsis, as Dr. Best did, but never did I outline a definite technic as Dr. Best has done, and with Dr. Best's efforts along lines of asepsis I know that he can save many pulps that the average dentist would not think of saving because I could recognize from the discussion by him that he understands pulp pathology, and it is one thing dentists as a rule do not understand. That there are different kinds of hyperemia, active and passive, arterial and venous, and the steps that lead up to tissue inflammation of the dental pulp itself, are little understood, and many of these pulps, if handled as Dr. Best suggests, can be saved and the teeth made comfortable and useful for years with a healthy pulp. I have told these radical extractionists that if we can find streptococci, the so-called green-stain streptococci, in all the areas seemingly involved, we should drill through the healthy gum tissue and bone, and we will find the streptococci there. Pollia, formerly of San Francisco, now of Los Angeles, did that unknown to me, and, in many instances, found streptococci in these normal cases. Pollia found the same bacteria in the healthy bone that were found by Haden and others in cases in which there was positive roentgenographic evidence of infection. The presence of bacteria and infection are not synonymous, and while Dr. Best asks us to remember that and says that if we remember only that, it is worth the time we have spent here this morning, let me ask you to remember that when we have an infection we have cellular change and an inflamma-

tory reaction. Without this, the presence of germs in a tissue is of little significance. There are a few men in the profession who are working hard on the pulpless tooth problem: Coolidge, Blayney, Hatton, Grove, Hall, Best, Rickert, Johnson and others. Rhein and Callahan have worked along this line for years. It is not easy. If we did not have confidence in the things that we are doing, we too would follow the easy road, but some men have a conscience, that which the surgeon calls "tissue conscience," and the surgeon who operates without that tissue conscience is a menace.

THE TREATMENT AND FILLING OF VITAL DECIDUOUS TEETH*

By JOHN E. GURLEY, D.D.S., F.A.C.D., San Francisco, Calif.

IN a discussion of filling materials for deciduous teeth, the question of cavity preparation is of significance. But in cavity preparation in these teeth, the knowledge of dental anatomy is of even greater importance than in similar work on the permanent teeth.

DENTAL ANATOMY

The outstanding feature of the deciduous teeth is the size of the pulp chamber in proportion to the size of the tooth or the thickness of dentin and enamel. It is very large, a fact, which, with the frequent high extension of pulpal horns, renders cavity preparation dangerous to the pulp.

Then, too, caries occurs most frequently interproximally between the first and second molars and the cuspids and first molars, with a consequent settling together, or may I say, compression.

These two statements give a clear picture of the affected field in which we are to work; and in its restoration, the entire dental anatomic field must be held in mind. Restoration must include not only teeth to normal position and relation to the approximating teeth; but also attention to proper contour and contact; buccal and lingual margins, which must be well extended, and fillings, which must be polished to a smooth surface with smooth margins, which insures proper relations to the soft tissues. Finally, proper relations to antagonizing teeth must be established. We should realize the value of dental anatomy more keenly every day, and during the period of deciduous dentition, this is no less imperative.

We should note further that in the deciduous teeth the pulp is largely vascular, which promotes both constructive and destructive function, with the result that the fibrillae are not so well developed as in the permanent teeth and concomitantly not so sensitive. Hence, cavity preparation is much less painful and, in many cases, not at all painful, except as the pulp itself is approached, or when, from the use of dull burs, too much heat may be evolved.

CAVITY PREPARATION

The first step in cavity preparation, which is dependent on the conditions

*Read before the Section on Mouth Hygiene and Preventive Dentistry at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 22, 1928.

actually obtaining, is to cut away sufficient tooth substance that baseplate guttapercha may be inserted and left in for a few days, compression, as a result of use, separating the teeth and thus forcing them back into their normal positions.

Then, in the actual preparation, with a No. 34 inverted cone bur, we begin cutting in the pit on the opposite extremity, close to the marginal ridge, maneuvering buccolingually until through the enamel and then working toward the

Fig. 1.—Tooth having a large pulp chamber and a thin layer of dentin and enamel occlusally. The height of the pulpal horn is to be noted.

open cavity. In so operating, the tendency is to pull upward and away from the tooth and pulp, which affords protection. This is repeated with a No. 36 inverted cone bur, cutting wide; then with the large enamel hatchets, special No. 50, the margins are trimmed off and the occlusal portion is well prepared. The proximal portion may be generally prepared by use of the same hatchets and the binary or straight chisel, No. 20, the choice depending on whether the tooth is a lower or an upper. It may be necessary to use a fissure bur, No. 701, straight or contra-angle, but this must be done only with extreme care. A large spoon excavator, No. 63, serves well in cleaning up the gingival wall. The axiopulpal angle should be rounded off and all margins trimmed with the hatchets, and the cavity is ready to fill. The use of large instruments is a protection in these cases.

Should there be a cavity on the surface of the approximating tooth, not involving the marginal ridge, it may be prepared as a simple cavity on that surface. Cavities in the cuspids and anterior teeth may be prepared as simple approximal cavities. In these, the lingual dovetail is often valuable.

Fig. 2.—Size of pulp chamber in proportion to thickness of tooth structure.

Preparation of gingival cavities in all teeth is carried out as taught in operative dentistry, caution being always exercised not to go too deep.

FILLING MATERIALS

Guttapercha has its greatest use as a temporary filling and for separation as previously suggested. It may occasionally be used in fillings of a more lasting nature, but is not desirable on account of its compressibility and absorptive power.

Cement has a wider range of usefulness, though it must always be considered as a temporary filling, for it washes out and does not maintain contact. Work on the deciduous teeth must not be considered as temporary for it must last for a definite period.

The copper cements, black, red and white, have some value in that they possess certain germicidal properties and may be placed in those locations in which complete removal of decay is impossible. They may be used in cases of badly broken down teeth in which all possibility of retention is gone and in those cases in which the tooth or teeth are to be retained for only a short period of time.

Fig. 3.—Hypoplasia. All spots are to be filled with copper amalgam.

Copper cement may be used in the fissures of first permanent molars, to which reference will be made later.

The locations that may be adaptable to copper cements may also be adaptable to the zinc cements, except that the latter have no germicidal properties.

The silicate cements have no field of usefulness in the deciduous teeth.

Amalgam is the filling par excellence for the deciduous teeth, yet discretion is required in using it. Copper amalgam is not only very useful in pit, approximal and gingival cavities, Classes 1 and 5, but is indicated as well. In cases of hypoplasia, we trim out these hypoplastic spots and fill with copper amalgam, which here serves almost as a specific. In compound cavities on the molars, Class 2, it has not sufficient strength to resist wear as it cups out and flows.

Silver amalgam possesses those properties lacking in the copper amalgam, but silver is the best conductor, and hence becomes an irritant and will cause, in too many cases the death of the pulp. Here, then, both come into use. The floor of the cavity may be covered with copper into which the silver amalgam is packed, the combination affording both protection and strength; for the former is nonirritating and even manifests germicidal properties.

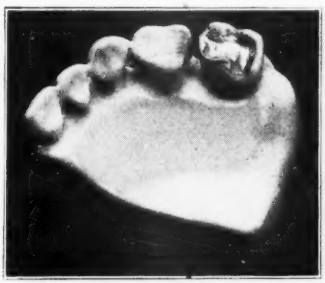


Fig. 4.—Type of fillings, made wide occlusally to give strength.

Gold has little or no use in deciduous teeth. Occasionally, it may prove cheaper to the operator and desirable to use; otherwise, it has no advantage over an amalgam filling.

PULP EXPOSURE

If the pulp is exposed owing to the progress of caries, it had better be removed. This is best accomplished by the

use of arsenic, fiber or paste sealed in for twenty-four hours. But if it should be exposed in cavity preparation, capping may be indicated and accomplished by placing over it a paste made up of a powder of tricalcium phosphate, 32 parts, and thymol, 6, with liquid menthol, 2.6; thymol, 5.2, and phenol, 24. This is mixed to a thick paste and placed over the exposed pulp, excess liquid being removed by means of a pledget of cotton. The paste is then covered with a thin film of cement, and the filling inserted.

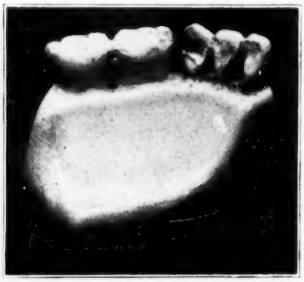


Fig. 5.—Type of filling, showing lingual dovetail for anterior teeth.

FIRST PERMANENT MOLARS

The care of the deciduous teeth must include consideration of the first permanent molar. They are all in the mouth at the same time and all require attention. In fact, this is the real preventive effort of our work. That many or most of these teeth present deep fissures which are most liable to decay early is well known, and hence attention must be given them early.

For years, it had been our practice to clean out these fissures, wash with silver nitrate and fill with cement, but cement washes away, and there are sorry results. We now follow the advice of Thaddeus P. Hyatt, cutting out these fissures and filling them with amalgam.

CONCLUSION

Filling deciduous teeth, or dentistry for children, is operative dentistry with slight modifications. We must think in terms of dental anatomy and use greater care in cavity preparation. We cannot go deeply into these teeth; therefore, we must cut widely in order to have enough filling material to assure strength.

Dentistry for children is preventive dentistry in its true practice and must be considered in that light. Phillip Brooks once said: "He who helps a child helps humanity with a distinctiveness which no other help given to human creatures in any stage of their human lives can give." This is true socially, mentally, spiritually and physically. To aid the child physically is ours to do: let us do it.

350 Post Street.

DISCUSSION

C. L. Drain, Iowa City, Iowa: Too many times, we are apt to tinker with these deciduous teeth: take a round bur and literally scoop out the caries, make a hole and then plug it, so to speak, with cement. Too much emphasis cannot be placed on the preparation of cavities in these deciduous teeth in order that they may be retained, as has been suggested by Dr. Gurley, until they are normally lost. It is not so difficult to prepare cavities in deciduous teeth, operatively speaking. It depends a great deal upon the handling of the patient. May I add just a word in regard to the preparation of cavities, something that we have tried out very thoroughly and that is proving very successful? We all have had cases with a proximal cavity and little or no caries in the central groove or pit. In those cases, we have been very successful in taking a No. 18 stone, a wheel stone with a knife edge, simply placing it in the pit or sulcus and drawing the pit toward the caries on the proximal and opening the occlusal surface. It can then be widened laterally with

the stone very quickly. These stones are heatless and, with care in handling, cause no pain whatever. Dr. Gurley very aptly considers amalgam, especially copper amalgam, as the best filling material for deciduous teeth. In our clinic, in the preparation of cavities and especially when there are not a number of large cavities, we do not follow out extension for prevention because we use copper amalgam and believe from experience that caries does not recur around the margins of a copper filling properly manipulated and placed. With regard to the manipulation of copper amalgam: the ordinary method with copper amalgam is to triturate into a common mass, into an adhesive mass, placing it in a 6 by 6 napkin, usually doubled, and wringing it out with the fingers. We like to use a pair of parallel pliers and a chamois skin and squeeze the mass until it is dry, a dry disk. Last year, someone asked me if I had ever weighed a mass of copper amalgam by expressing the mercury with the fingers and a 6 by 6 napkin and then by another method, using a pair of parallel pliers and a chamois skin. I found that we are able to express an average of 12 per cent more mercury by weight out of copper amalgam by using flat-nosed pliers and an ordinary chamois skin; which means that we have less flow after the filling has been placed, less cupping out (as has been suggested by Dr. Gurley as one of the disadvantages), and somewhat more strength. Also, the mass sets in about one-half the time outside the mouth. Concerning the use of copper amalgam plus silver amalgam in proximoclusal cavities, that is, the placing of a copper amalgam lining, Dr. Gurley has suggested using the lining only on the floor of the cavity. May I add a suggestion to line the entire cavity and then place an amalgam inlay in that lining. We have the germicidal protection of the copper amalgam along the entire floor, walls and margins, and the strength on the marginal ridge of the silver amalgam. We all know that copper amalgam has germicidal properties, and about four months ago, the question came to my mind as to whether there was a dilution of the germicidal properties when the silver amalgam was incorporated into the copper amalgam. I took a metal mold and lined that with copper amalgam, placing inside of that the silver amalgam inlay; taking two of those the same size, two of copper amalgam the same size, and two of silver amalgam; six in all, two of each. These were placed in a petri dish with growing mouth organisms, and within three days we examined them and found that there was dilution to a marked degree, and it lasted throughout several weeks. We observed these petri dishes nearly six weeks. The silver amalgam was right in the middle of a large colony of mouth organisms. The copper amalgam had an area around the disk of copper amalgam free from colonies of mouth organisms, about one-eighth inch all the way around, and the organisms grew right up to the mixture of silver and copper amalgam. So that while we have added strength on the marginal ridge, we do have a distinct dilution of the germicidal effect of this mixture. Do not believe that it is not a commendable operation: it is. There are many cases, especially where cavities extend buccally and lingually beyond the line angles in these deciduous teeth, in which we must have strength on the marginal ridge in order that our filling shall hold up, and copper amalgam is not so strong in any case as the mixture or as a silver-tin alloy alone. Dr. Gurley is right in stating that cement, either zinc or copper, should be considered as a

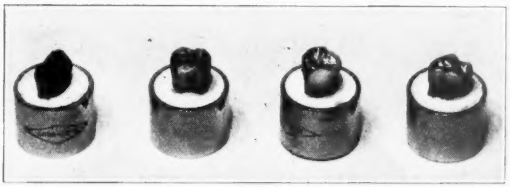


Fig. 6.—Types of fillings: cement, amalgam and gold inlays.

temporary filling. And the quicker we as dentists realize that the placing of a cement filling in a deciduous tooth is only a temporary act, the sooner we are going to save more teeth. Now just one more thing, the important thing of filling the fissures of first permanent molars. In Forsyth Dental Infirmary in 1915, one out of every three first permanent molars, 50 per cent of which had been treated, were extracted. In 1918, after the inception of this protective method, one in five was lost. In 1924, one in every 200 was extracted. And this was accomplished only through the simple opening of these noncarious fissures and filling them with amalgam; not with cement.

S. D. Harris, Detroit, Mich.: We cannot speak too strongly for thoroughness and conservatism in the cutting of deciduous and permanent teeth in children. In any mouth in which a cavity is to be prepared, all

Fig. 7.—Fillings in deciduous molars.

of the decay should be removed. Certain concerns at the present time that are putting out proprietary preparations of cement claim that if a certain amount of soft decay is removed and the remainder left in and their cement is used, the deciduous tooth or the permanent tooth will not be harmed. That does not stand to reason and it does not work out in practice. The treatment of permanent teeth and the treatment of deciduous teeth run along in parallel channels. The preparation of the cavity is similar. In the preparation of the cavity of a deciduous tooth, the two things of primary importance are: (1) to remove all decay; (2) to do as little cutting as possible. I had this lesson brought home to me rather definitely some time ago. It used to be my custom, in all deciduous molars that had proximal decay involving the margins, to perform a radical operation, remove the marginal ridge and carrying the cavity preparation onto the occlusal as we would in a permanent tooth. Two of my patients went to California, Dr. Gurley's home. There they are exponents of copper amalgam and know how to use it. My young patients came back with tiny copper amalgam fillings. I am still taking care of these children, after two years, and those fillings look beautiful. I had tried to use copper amalgam, and it was never a success in my hands and I could not understand why. I think that there is not only a difference in the preparation of the material for insertion, but also the difference in copper amalgam. There are different types of copper amalgam, it seems. The preparation of the copper amalgam was given by Dr. Drain. If you wish to know just how much mercury can be expressed from copper amalgam after it seems to be ready for insertion by the ordinary method, put some of it in a chamois cloth and use a flat-nosed plier.

Fig. 8.—Normal teeth.

You will be surprised at the amount of mercury that is squeezed out after it seems to be thoroughly dry. In selecting a copper amalgam, I can merely suggest that since there are different types of copper amalgam, the best way for the individual to work out the problem for himself is to take the copper amalgam of the different concerns. Try each one of them. Roll them up in a ball and see what you find out after you have let them stand for two or three weeks. You will be astounded at the results. The reason many of us do not have success with copper amalgam is sometimes not due to the fact that our technic is not so good as it might be, but to that difference in copper amalgam. As far as other filling materials are concerned, I wish to mention another one that may be of interest here. Some of the older men probably have tried it. It was suggested to me by Dr. Ward of Ann Arbor. No large amalgam restoration should be

placed in a deciduous tooth without a cement base. As sure as we put in a large amalgam filling without a cement base, as sure may you be that, in six months at the utmost, you will find that the tooth will develop fistula. The way to prevent that is to use the amalgam inlay. Many of you may know what the amalgam inlay is. It is placed exactly as is a good amalgam filling, except for this one point: a little soft red copper cement is placed on the proximocervical angle of the cavity (we will say that it is a compound cavity) with the point of an explorer. We then put the amalgam in, forcing this cement up along the side of the tooth and over onto the occlusal surface. This serves two purposes: It not only affords a germicidal cement base, but it also aids in retaining the filling. Dr. Ward showed me two teeth that he prepared in that way, and these teeth could be thrown against the side of the wall in these cases. Occasionally, when the depth of the cavity will permit and conditions are right, we may place a cement lining. Silver nitrate has practically no place in my office. Occasionally, in certain abrasive areas, generally cervical, where food is packed and there is a slight disintegration of the enamel, we may polish smoothly and apply a little silver nitrate. We have used silver nitrate in washing out deep fissures, but as to bringing it in contact with the dentin: no; because (1) it discolors, and (2) it is irritating and penetrating and is therefore liable to penetrate too deeply and injure the pulp. We may precipitate with eugenol or a 40 per cent solution of formaldehyd, preferably eugenol, but we have such an intense discoloration that I do not use it. Therefore, as I have said, silver nitrate has practically no place in our office. As to the matter of cavity sterilization and the removal of decay,

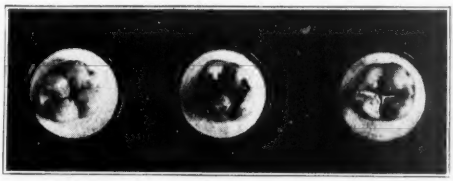


Fig. 9.—Treatment of first permanent molars. The deep fissure shows two points of decay. Formerly, the fissure was cleaned out, washed with silver nitrate and covered with copper cement, if no decay was present. It is now trimmed out and filled with amalgam according to the recommendations of Dr. Hyatt.

and the filling would stick. This suggestion is practical for compound cavities.

J. A. Stenborg, Minneapolis, Minn.: Dr. Gurley, what do you think of the use of silver nitrate in the treatment of deciduous teeth and permanent molars?

W. R. Alword, Detroit, Mich.: I should like to know whether Dr. Gurley sterilizes cavities prior to filling.

Dr. Gurley (closing): Occasionally, we use cement, but usually we do not. The cement takes up too much space if we use a sufficient amount to do any good, either as a protector in the cavity or to give strength to the filling. Copper amalgam serves exactly the same purpose as a copper cement; that is, it is bland and nonirritating. It prevents irritation through the silver amalgam, and that is what I am interested in there was a suggestion made that it is impossible. It is not possible to remove all of the decayed dentin from the greater percentage of cavities in deciduous teeth. If we do, exposure results, and that would mean devitalization. It is better to fill the tooth, as I described, with copper amalgam or cement and silver amalgam, even including pulp capping. The number of devitalizations under this treatment is so small that we are safe. If we have devitalization under a silver filling and an abscess develops, it makes little difference. It is an easy and a sure way to devitalize the tooth, which may be made a useful member by canal sterilization and filling. Finally, decayed dentin must be removed, as far as possible and the principles of cavity preparation as laid down by Black carried out, with slight modifica-

tions. I suggested that working on deciduous teeth is operative dentistry, modified. Therefore, we follow the rules as given by Dr. Black for cavity preparation just as far as we can and with slight modifications; that is, we make the cavities wide and not too deep; remove all of the decay that we can; wipe out the cavity with phenol or phenol and alcohol, and dry; place copper amalgam and over that (the copper amalgam shows disinfectant property), silver amalgam; build up the contour and the contact; and trim down for the occlusion. Satisfactory results follow.

SOME CLINICAL MANIFESTATIONS OF ORAL FOCI OF INFECTION*

By C. E. ERVIN, M.D., Danville, Pa.

A THOROUGH understanding of the important subject of clinical manifestations of oral foci of infection, by both the medical and dental professions, probably offers more to safeguard the health and usefulness of our people than any other single health measure available today. Smallpox, typhoid fever, puerperal sepsis, anthrax, scarlet fever, diphtheria, yellow fever and a host of other acute infectious diseases are now sufficiently understood to make their control feasible, but our professions, as a whole, are just beginning to awaken to the results of the chronic infections which have their foci in the oral cavity.

For this awakening, we must be grateful to those pioneers who have long since seen the light of day and have gone ahead with their educational efforts in spite of all the discouragements that are common to new ways of thinking. We have been nearly a quarter of a century in reaching our present conception of chronic focal infections. For the good of all concerned, progress must be much more rapid during the next few years.

The facts, as I see them, are these: No physician can do the best for the patient who falls into the group under discussion today, unless he has the assistance of a dental consultant. The importance of this particular service is as great as any other special assistance that he utilizes. If the management of these patients is to be successful, no stone must be left unturned in reaching a diagnosis. If, for example, we are satisfied that a maxillary sinus infection is causing all the symptoms, without having the patient studied from the dental point of view, we are liable to subject him to needless and useless radical surgical procedure.

It is quite clear, therefore, that the study of focal infection is a problem for diagnostic teamwork. The internist or physician, in the first place, must recognize symptoms that point to focal infection. The oral diagnostician must identify the infection, if it falls in his field, and give appropriate treatment, and so on for the other specialists concerned. All must have a working knowledge of the problem of focal infection.

*From the Department of Medicine of the Geisinger Memorial Hospital.

*Read before the Section on Oral Surgery, Exodontia and Anesthesia at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 21, 1928.

It is quite evident that a dental consultant is absolutely necessary in the management of all these patients. If that consultant is to be of value, it is essential that he be especially trained in oral diagnosis and treatment and that he have a thorough understanding of the influence which focal infections have on the general health. Unfortunately, that type of man is not available, at this time, in every community, but there are signs to indicate that the educational trend is toward the training of such men. Let us active practitioners lend all encouragement possible. And, in this connection, let me say that joint meetings of the two professions are extremely helpful. It is the custom of our county medical society to turn over at least one meeting each year to an oral diagnostician, so that we may get his ideas on the various diagnostic problems and treatment in focal infection.

In reviewing the following cases, to A. B. Vastine I acknowledge my indebtedness for the notes on oral diagnosis and treatment.

In view of the fact that the arthritides, the most important single group, have been most talked of, I shall pause only long enough to mention a few salient points. We must remember that when a joint is once damaged its function may never again return to normal. From slight impairment, the damage may go all the way to absolute crippling; hence, the importance of prophylaxis and early vigorous treatment. Remember also that the onset of chronic joint infections is usually insidious and that the patient is liable to have a number of warnings in the form of light joint pains, neuralgia and myalgia for months before the joint symptoms bring a realization that the condition is arthritis. We feel emphatically that arthritis is infectious in origin and that it is a dangerous assumption to put any of these cases into the class of metabolic disturbances. Even gouty manifestations are often precipitated by infection. Good food, in abundance, is of the greatest importance in the treatment of the chronic cases. The patient's appetite, and not a laboratory report, is the best guide as to the sort of food to be taken. Fresh fruits, craved by the patient and so very necessary, are often avoided through prejudice that has passed from generation to generation.

The subject of arthritis which is precipitated by traumatic insult, or so-called traumatic arthritis, is one of growing importance. Many of these cases are coming before the compensation courts, and medical testimony regarding them varies widely. The most common seat of this form of arthritis is in the lumbar spine. The patient usually gives a history of some injury, often a slight one. Soon afterwards, the symptoms appear. When one comes to examine the patient, the usual oral focus is found to be of either dental or tonsillar origin. The trauma lessens resistance sufficiently for the active infection to take place. Unfortunately, clearing up the focus does not always relieve the patient once the joint has been damaged.

No more than brief mention need be made of acute rhematic fever. An oral focus is usually demonstrable, most often in the tonsils, which we try to have removed as soon as the acute symptoms have subsided. If these symptoms tend to continue for several weeks, it is well to proceed with the necessary operative measures. The fact that a serum is now on the market for treatment of acute rheumatic fever does not lessen in the

least our responsibility in this disease. The patient may be safe without serum, but not without the specialist who is going to remove the source of his trouble.

A large percentage of our chorea (St. Vitus dance) cases have been of dental origin.[1] Of course, there are other factors to be considered in chorea, such as tonsillar infections and pregnancy in young women. The following cases are cited as examples of the different types:

REPORT OF CASES

CASE 1.—*History.*—N. L., a girl, aged 11, presented a case illustrating several points of interest; first of all, that choreiform movements may be relieved by dental operations, and that an infectious factor was not influenced by the procedure. The patient was admitted Jan. 9, 1928. She had been well until twelve weeks previously, when she had an acute upset which was termed a bilious attack. About a week later, she became nervous and irritable, and a diagnosis of valvular heart disease was made. About one month from the onset of her illness, she had her first nosebleed, which required a nasal packing; a symptom not infrequently seen in malignant infections. After the nosebleed, she did not do well, and shortly developed nervous symptoms, such as thickness of speech, heaviness of the tongue and incoordinated movements of the hands and arms. There was nothing in the past medical history of particular value. A tonsillectomy had been performed two or three years previously. She had scarlet fever in October, 1926.

Examination.—The patient was an anemic looking child, quite emaciated, and suffering with marked involuntary incoordinated movements of all parts of the body. These choreiform movements included the eyes, mouth, tongue and face muscles, as well as the extremities. She was helpless and could not feed herself. The tonsillar fossae were fairly clean. The heart was enlarged to both the right and the left. The sounds were booming, the rate was rapid, and a to-and-fro murmur was heard over the mitral area.

Operation.—The dental operation was performed, January 14. Following are the operative notes: Diagnosis: Periapical and cystic dental infection. On the right side was a badly broken down first molar, the root being decayed almost to the tip, with a large granuloma which involved the mandibular canal. The lower left first molar was not so badly decayed at the roots, but the tooth was entirely gone. The granuloma involved the mandibular canal even more definitely than on the right side.

Outcome.—Within the first twenty-four hours after the operation, the choreiform movements were much less marked, and at the end of forty-eight hours, the patient could feed herslf. The chorea rapidly improved, but the heart condition grew worse, and the patient died twelve days later of a typical infectious pancarditis with failure.

CASE 2.—*History.*—Jennie S., aged 18, was tranferred to the Geisinger Memorial Hospital from the Danville State Hospital on account of chorea insaniens complicated by pregnancy. This case is cited to illustrate a chorea major which had its origin in a stimulus, probably a mechanical one, far from the oral cavity. She had been taken to the state hospital for treatment on account of the foregoing mental diagnosis. The chorea and mental symptoms had their origin coincidentally with the onset of pregnancy, six months previously.

Examination.—When the patient was admitted, she was in almost a dying condition. She was completely irrational and was threshing around in bed in a wild fashion, every muscle of the body apparently involved in extremely active incoordinated movements. The mouth and tongue movements were particularly characteristic. She was markedly dehydrated and the skin was abraded wherever exposed.

Treatment and Outcome.—Labor was induced and the pregnancy terminated within the first forty-eight hours after admittance. During the following night, she showed improvement and rested much better. She was discharged from the hospital on the eighteenth day, completely free from the choreiform movements and apparently clear mentally. She was discharged from the state hospital shortly after leaving us.

Various forms of neuralgic conditions are met with in these chronic focal in-

1. Vastine, A. B.; Atlantic M. J., 31-564 (May) 1928.

fections. The history is usually one of several years' standing. The attacks come and go at irregular intervals. The symptoms may shift from one part of the body to another and are often precipitated by changes in the weather. The damage is usually not extensive, and hence recovery, after removal of the cause, is prompt. The one notable exception to this is evidenced when the greater sciatic nerve is involved. In this instance, we often have a true neuritis. Recovery is slow, often requiring weeks or months. Under the same heading, subdeltoid bursitis should be considered. The condition is always infectious, but sometimes it is precipitated by trauma. Fortunately, the bursa will stand repeated insults of this sort before permanent damage results.

Nonspecific aortitis with or without chronic myocarditis falls into the same category. Contrary to the usual teaching, these cases are often not due to syphilis. Here again, the treatment is to be applied before the damage is done. I have some hesitancy about citing the following case as the dental diagnosis is incomplete.

Case 3.—*History.*—George D., aged 36, was admitted to the Geisinger Hospital, Oct. 17, 1924, complaining of "gas on the stomach and pain over the heart."

About four weeks before admission, he was struck with a substernal pain which developed while he was walking leisurely up hill on his way to work. He had to stop until the pain subsided. After the onset, he had about seven attacks which came on while he was quiet, and many that were precipitated by slight exertion. He had one attack accompanied by vomiting and a pain which ran down into his right arm. The appetite was always good, but sour food never agreed with him. (He had an attack of diarrhea with about ten watery stools daily two years before the last illness. Afterwards, he occasionally had such attacks.) There was no history of constipation. The patient was somewhat nervous. The venereal history was negative.

Examination.—The patient was well nourished but of a neurotic appearance. When he first came to my examining room, he was practicing aerophagia in an unusually noisy manner, and from this, I thought him a neurotic. The dental examination revealed several pupless teeth and many crowns. The tongue was heavily coated and the breath offensive. Pus was expressed from the tonsils. The heart sounds were distant but regular, with no murmurs. The aortic and pulmonic second sounds were about equal. The heart was moderately enlarged to both the left and the right. The blood pressure was: systolic, 100, diastolic, 75. Liver dulness was not noted below the costal margin. The blood Wassermann reaction was negative. Roentgen-ray examination revealed a mild dilatation of the heart, but the arch of the aorta was normal in size. There was also bilateral peribronchial thickening, with passive congestion. The temperature was of a low-grade, septic type.

Diagnosis and Treatment.—The nose and throat consultant, Dr. Nebinger, confirmed the diagnosis of chronic tonsillitis; but on account of the aortitis, he declined to operate, and the patient was discharged from the hospital. Several weeks later, he was sent back by his physician, who asked for the operation in the hope that some relief might be afforded the patient. A tonsillectomy was performed November 25.

Outcome.—The patient left the table in good condition, but about one-half hour after he returned to his room, death occurred suddenly, evidently from an acute dilatation of the heart and a massive air embolism.

Necropsy Report.—The postmortem examination revealed crepitation in the left ventricle before it was opened. The wall of the left ventricle was thinner than usual, bulged on cutting and had lost its beefy striations. The heart was widely dilated, both to the left and to the right. The intima of the aorta was thrown up into padlike elevations which were irregularly distributed over the surface. The elasticity was retained. The sclerosis did not involve the valve leaflets but extended to the coronary vessels.

The impressive facts in this case are the dental and tonsillar infections and

the severe substernal pain in a healthy looking man due to an aortitis which involved the coronary vessels.

Secondary anemia is a common finding in chronic infections. Many times this can be explained in part by an inadequate, self-imposed or prescribed diet. Before the anemia is grossly appreciable, many other symptoms are complained of, especially a feeling of being tired after arising in the morning, fatigue that comes long before the day is over and irritability. The merchant will often tell you that he hates to see a customer come in; or the doctor, a patient. The patient often goes to the physician asking for a tonic to build him up. When you inform him of his focal infection, he usually tells you, with a feeling of assurance, that his teeth are good for he goes to see his dentist every six months and that he never had a sore throat in his life. He, of course, fails to realize that pain is not a symptom of chronic, dental or tonsillar infections.

The primary lesion of subacute bacterial endocarditis can usually be found in the oral cavity; hence, the prophylaxis is of the most profound importance, for the reason that, when the infection is once engrafted on the heart valves, or other parts of the endocardium, it generally runs a long course and terminates in death, not more than 8 per cent of patients recovering. The following cases will illustrate my point:

CASE 4.—*History.*—W. H. C., a man, aged 43, was referred to the Geisinger Memorial Hospital, Feb. 16, 1926, on account of a continuous fever. Three months previous to admission, the patient noticed that he was suffering from what he termed a rundown condition and night sweats. About this time, a decayed tooth in the lower jaw abscessed and was removed. Dec. 25, 1925, he had a sharp pain in his left chest, which lasted only a few days.

Examination.—His physician first saw him about Jan. 1, 1926, and found his temperature varying from subnormal to about 101 to 103 in the afternoon. Night sweats continued throughout his illness. The heart was enlarged, and there was a to-and-fro murmur over the mitral area. The heart was fibrillating, but there was no failure. The blood culture was positive for *Streptococcus viridans.* A dental roentgenogram showed a cyst involving almost the entire mandible.

Operation and Outcome.—The mandibular cyst was removed, March 2, without promising the patient very much. He continued to run a downward course and died the following June.

CASE 5.—*History.*—L. C., aged 19, was admitted to the Geisinger Hospital, Oct. 8, 1926, complaining of pain and soreness in the joints. She had enjoyed good health until January 15. Previous medical history showed that she had scarlet fever as a child, chorea at 7 and inflammatory rheumatism at 9 years of age. She had had a tonsillectomy in 1922. The present trouble began rather suddenly, January 15. She had attended a dance and went to bed feeling well. The following morning, she awoke with severe pains in the left hip, which she found that she could hardly move. She was taken to a hospital, where she remained for four weeks. The pain mainly localized in the left hip during that period. After the patient left the hospital, she felt pain in the right hip, but this was not so severe. Later, both shoulders, and finally all the large joints. were involved. The wrists and finger joints only were swollen and red. Three months previous to admission to the Geisinger Hospital, she began to notice "spots under the finger nails," about the size of a pinhead, which remained for three or four days at a time, and then faded away. During her entire illness, she had fever of a septic type.

Examination.—The patient presented the usual anemic appearance of one suffering with a chronic blood stream infection. Repeated showers of petechiae were noted not only under the nails, but also in the palms and on other parts of the body. There was no dyspnea during any of her illness, and no cyanosis. There was some swelling of the joints, mentioned above, and the patient complained a great deal of pain. Examina-

tion of the mouth revealed a number of pulpless teeth, but the tonsillar fossae were clean. The heart was not enlarged, and the rate and rhythm were regular. A presystolic thrill was felt best at the apex, and a presystolic murmur was heard in the same area. The sounds at the apex were crescendo in character, the second sound being accentuated. The blood pressure was: systolic, 100, diastolic, 80. The spleen was not palpable.

Outcome.—The case ran a rather typical course of subacute bacterial endocarditis. The patient was admitted to the hospital, October 8, and died, March 19. Her temperature was of the septic type and varied from subnormal to as high as 104, but the average was not much above 99. The pulse rate was rapid, averaging close to 95. The blood culture showed a green-producing organism which morphologically and culturally resembled *B. influenzae*. Roentgen-ray examination revealed a periapical dental infection of the lower right first molar and the lower second bicuspid and first molar on the left. The infection of right first molar involved the mandibular canal.

We believe that this infection came from periapical dental disease, and the case is cited in an endeavor to emphasize that, when subacute bacterial endocarditis is once established, death usually results, regardless of whether the focus is removed or not.

Pyelitis and cystitis can almost always be traced to an oral focus and should be treated accordingly. One can make no greater mistake than to overlook the primary cause in these cases, as otherwise there is usually a recurrence.

Case 6.—*History.*—Mrs. R. S., aged 51, was admitted to the Geisinger Hospital on Jan. 18, 1928, complaining of blood in the urine. For eight or ten years, she had suffered from repeated attacks of cystitis. Three weeks before admission, she again developed hematuria, burning, frequency and nocturia (seven to eight times). She also complained of a dull pain which extended from the pubic region up to the left side toward the hypochondrium. There was no improvement prior to admission.

Examination.—The patient had a few red cells in the urine when she came to the hospital and a large number of white cells. Cystoscopic examination revealed no bleeding, inflammation of the mucosa, especially over the trigon, and considerable débris in the bladder. The orifices of both ureters were red and injected, but catheters were readily admitted and the urine flow was free and apparently normal. Cultures showed gram-negative bacilli both from the bladder specimen and from the right and left ureters. Pathologically, a diagnosis was made of *B. coli* from all specimens. A pyelogram of both kidneys was negative.

Treatment and Outcome.—The cystitis improved under treatment, but the patient continued to have a fever till the necessary dental work was done. Following are the operative notes: There was the usual periapical dental infection to be found in these cases except in the first and second molars above on the left, which involved the maxillary sinus. In the corresponding teeth above on the right, the infection involved the maxillary sinus and the tuberosity, this side being much worse than the other. The first molar below on the right was adjacent to the residual area from a tooth removed when the patient was about 9 years old. The second molar below on the right was only a root fragment, as was the third molar below on the left. Both maxillary sinuses were involved.

Outcome.—The temperature returned to normal immediately after the operation. The bladder symptoms promptly cleared.

This seems a typical example of infection of the urinary tract of dental origin.

Case 7.—Joseph Z., aged 28, was admitted to the hospital, June 16, 1928, complaining of "weakness and loss of weight," dating back less than one year. Although his work as electrical repairman was light, he was exhausted by the end of the day. For about nine months, he had been bothered more or less with a pain in the left kidney region which was dull and [illegible], not severe enough to keep him from his work or awake at nights. The pain did not radiate and seemed better when the bowels moved freely. (Constipation often aggravates the symptoms of disease extrinsic to the intestines; a fact

which is many times misleading.) There had been some slight urinary symptoms such as pain and burning on urination and nocturia (once). The urine always looked milky to the patient. He had not noticed any blood.

Roentgenograms revealed that the kidney was filled with multiple stones and that the patient had outstanding gingival and periapical dental infection.

When the patient left the hospital, after operation, he was instructed to return for dental work, to safeguard the other kidney.

Early prophylactic care probably would have meant prevention of all the trouble.

The relationship between bronchial asthma and infection in the oral cavity, especially when the maxillary sinus is involved, is today generally accepted. I wish to cite the following case which is a rather outstanding example of this type of trouble.

CASE 8.—F. S., aged 67 years, was brought into the hospital, Nov. 17, 1926, completely bedridden. His case had been studied in one of our best teaching hospitals, and his trouble pronounced cardiac asthma. A rather hopeless prognosis had been given. The patient did not show any improvement on cardiac treatment. After we had an opportunity to study the case, we all felt that the chest symptoms were due to bronchial asthma, and that the heart was not unduly affected. Progress since that time has proved our contention. The patient had a rather outstanding periapical and gingival dental infection with polypoid degeneration of the left maxillary sinus of gingival origin. He had excellent health after we were able to persuade his doctor to permit him to get out of the house and lead a normal existence.

Prostatitis which is nonspecific in origin is also usually secondary to a distant focus, a fact that is probably not generally appreciated. In this connection, I wish to cite the following case, in which there was not only a prostatitis, but a subdeltoid bursitis of a crippling nature.

CASE 9.—Dr. S., aged 44, had been troubled for years with prostatitis, which at times became acute and suppurative. There was no history or evidence of a gonococcous infection at any time. The prostate was large, boggy and tender. The prostatic smear was purulent. The patient finally came down with a subdeltoid bursitis of the right side. Not only the bursitis but the prostatitis cleared up when the gingival and cystic dental infection was overcome and a tonsillectomy performed. The first molar above on the right, the first bicuspid and first and second molars above on the left, and the first, second and third molars below on the left were involved by an end-stage cyst.

The part often played by dental infections as a direct or contributory etiologic factor in various eye conditions, such as iritis, iridocyclitis, retinitis and affection of the macula, is recognized. The following case was an unusually obscure one, as you will see from the history:

CASE 10.—Frank M., aged 40, had an acute empyema of the left maxillary sinus one year previous to onset of the eye trouble, which seemed to follow the extraction of an apparently sound tooth. At that time, the patient was under the care of a physician for a progressive loss of vision, almost total in the left eye and partial in the right. He was referred to specialists in a nearby city who had a study group. Sinus infection was suspected but none could be demonstrated. On his own initiative, the patient came to the Department of Oral Surgery of the Geisinger Hospital for study, Oct. 3, 1925, where it was demonstrated that a polypoid degeneration of the maxillary sinus had been established in connection with osteitis of the sinus wall, having its origin in a gingival infection associated with the upper third molar. Each link in this chain was established by roentgen-ray and bacteriologic findings. The pathologic condition was cleared up by operation, Jan. 26, 1926, and a vaccine was made from the polyp and a gingival culture. The sinus was irrigated with 5 per cent mercurochrome, and the lesions promptly responded. At the present time, complete vision is restored in the right eye and in the left eye except for direct vision.

The condition is not uncommon, and one occasionally encounters a case of massive, nonsuppurative cellulitis of the neck or retrolaryngeal abscess of gingival origin.

CASE 11.—L. D., aged 56 years, presented a case illustrating the possibilities of gingival infections causing an extensive cellulitis of the neck which had its origin in the retromolar area on the right side. The infectious process extended to the peritonsillar region and later to the neck. The patient was admitted in a critical condition and was hardly able to get his breath owing to pressure on the trachea. His illness dated back several weeks and had been characterized particularly by difficulty in breathing, which had been progressive in its nature. This symptom was due to pressure and not to cardiac failure. The patient was in an almost dying condition when admitted. Postmortem revealed an extensive cellulitis of the neck, which resulted in a great deal of pressure about the trachea. This infection had had its origin in the retromolar space on the right side.

The relationship between focal infection and toxic goiter has not been definitely established as far as I know. Many volumes have been written on the subject of hyperthyroidism, but most of it deals with the clinical aspect of the disease, the pathology, the iodin content of the gland and the technicalities of management rather than with a serious consideration of the cause. David Marine and his co-workers clarified the question of iodin deficiency as a cause of the thyroid enlargement of adolescence, some years ago. Renewal of the age old idea of giving iodin in toxic goiter has proved of value preoperatively, so that the patients now enter the hospital with very good prospects that an operation will restore them to health. But, as far as I know, little is being done toward the prevention of this disease. It is my opinion that removal of all foci of infection associated with the oral cavity will lessen the incidence of toxic goiters very materially. If you doubt this, note for yourselves the fact that almost every one of these patients presents a glaring focus of infection. When once the symptom is well established, it cannot be cured by clearing the foci. That should not be done until after the thyroid operation. Our greatest service is in preventing this disease.

One of the largest groups consists of those ordinarily classed as neurotics. Many times, in these cases, infections have a predilection for the central nervous system. An individual will show chiefly the symptoms, whether reflex or direct, which make him or her a neurasthenic. The patient feels and complains of being nervous. Pain may be complained of with frequency but, on close questioning, it will usually fail to reveal any characteristics of fixed disease; in other words, the pains are of the fleeting character. Another individual may be depressed or may even develop a psychosis.

The temperature chart is an invaluable aid to diagnosis in these chronic infections, and when the temperature is taken for several days and recorded on a graphic chart, it will show a variation from about 97.4 to one or more degrees higher. The temperature may be subnormal constantly, but never in my experience will it remain the same. Emphasis is laid on the variation in temperature, as it is one of the most constant findings in these cases.

Postoperative infections are often due to a localization in the operative field of the organisms which find their way there through the blood stream. The surgeon is too often looking for the break in his technic when the trouble is

coming from an oral focus. It is astounding to see, in almost any surgical clinic, the lack of attention to the patient's mouth. The heart and lungs are gone over, the blood pressure is taken, the urine examined, and blood chemistry tests are made, but a dangerous mouth condition, dental or tonsillar, or both, may be entirely overlooked. These patients should have the advantage of careful preoperative oral preparation by subgingival application of 5 per cent mercurochrome solution and 5 per cent arsphenamin in glycerin for at least two days before operation. The incidence of postoperative complications, such as pneumonia, phlebitis and wound infections, would then be materially lessened.

It is now a well-appreciated fact that pregnancy is complicated by greater toxicity in the presence of these foci. It is advisable to correct dental and tonsillar conditions even during pregnancy. In addition, there are frequently postpartum complications, such as unexplained temperature, phlebitis and breast abscesses, which can be attributed to these infections.

CASE 12.—C. B., aged 30, was admitted November 14, 1925, complaining of pain in the back of the neck extending up to the mastoid region on the right side. The symptoms had developed one week previously while the patient was on a motor trip. The past history was negative for similar trouble. Findings were negative as far as the sinuses and mastoids were concerned. It is fortunate for educational purposes that this patient had an oral diagnosis at the time, when the following notation was made: periapical dental infection of maxillary right lateral incisor and left first molar; mandibular right first molar, and second bicuspid and left first molar, with maxillary left first molar, involving the floor of the sinus.

The patient continued to have more or less neuralgic pain. Conception occurred the following May. Nausea and vomiting continued throughout the pregnancy. The lower left first molar developed acute periapical infection during pregnancy and was extracted. At no time would the patient consent to the complete clearing of this infection in spite of the fact that she was warned repeatedly of the possible danger. Delivery, Feb. 26, 1927, was uneventful except that it was rather prolonged. Following delivery, the lochia was normal, but the patient did not do well. There was no definite complaint for the first few days except weakness. The temperature fluctuated from 97.8 to 101.6 F. for the first eleven days after delivery, and she suffered a great deal with headache. On the twelfth day, she had a chill. Two days previously, a red spot was noticed on the left breast. This went on to suppuration and had to be opened, March 13. It is important to note that there had been no fissure of the nipples. The abscess was deep. There was no improvement in the general condition following operation. The temperature continued to range about 103. Toxicity was progressive. The pulse rate averaged around 160, the last few days of her illness. During the latter part of her illness, the temperature fluctuated from 8 to 10 degrees in twenty-four hours. Blood culture was positive for a hemolytic streptococcus. Death ensued sixteen days after the first chill.

The case was typical of massive blood stream infection. It also illustrates several points of interest, especially a septicemia of dental origin which resulted in a metastatic abscess of the breast and generalized symptoms. Contrary to the usual teaching, breast abscesses are often metastatic in origin.

In the diabetic patient, these chronic infections play a very important rôle, not only as a causative factor but in producing complications. A chronic infection also appreciably lessens the carbohydrate tolerance. The patient fails to regain his strength and vigor in spite of the best diabetic management. He will often complain of being susceptible to colds, which tend to persist. In

addition to this, metastatic infections may occur in any part of the body. One of my patients came in with a deep abscess of the heel following a bruise. There had been no abrasion of the skin. He had a dental focus of infection which was ready to furnish the organisms for the traumatized tissue, and an abscess resulted. Carbuncles, which are common in these patients, should usually be treated by poulticing rather than by radical excision.

Most of us have seen examples of fatal blood stream infections that occasionally take place when an acutely abscessed tooth has been removed. I recall one case, in a young woman who had apparently been in good health till she developed an acute periapical abscess. The tooth was removed by simple extraction without any preliminary subgingival therapy. In about five days after the tooth was extracted, the patient developed a septic temperature. She lost ground rapidly, living only about two weeks. A blood culture was positive for *Streptococcus hemolyticus*. Our experience leads us to believe that this complication can be prevented almost to a mathematical certainty by proper preoperative subgingival treatment.

Massive gastric and enteric hemorrhage in the absence of a demonstrable lesion, has, in our experience, apparently often been due to an oral focus. You will note from the following case report that hemorrhages were repeated till the infection cleared. As far as I know, no authors have considered an oral focus as a causative factor. Dieulafoy, who first described the symptoms, offered no explanation of the phenomenon.

Case 13.—George C., aged 27, was admitted to the Geisinger Hospital, Dec. 13, 1920, complaining of "hemorrhages from the stomach and bowel." In August, 1919, without any previous history whatever of gastric trouble and without premonitory symptoms, he had a large gastric hemorrhage. He soon regained his strength. One year later, he had a similar experience. He had no stomach symptoms in the meantime. The third hemorrhage occurred three days before admission to the hospital. This time, weakness forced him to quit work. The anemia was of the marked secondary type. Gastric analysis and fluoroscopic examination of the stomach were negative. The temperature on the first admission varied from 98 to 102.6 F. A transfusion was performed and the patient was dismissed much improved. March 22, 1921, he returned to the hospital a third time, on account of another hemorrhage. So far, nothing had been accomplished toward recovery, so I referred the case to my dental consultant. He found a cyst encroaching on but not involving the right maxillary sinus and suggested that clearing up this condition would probably restore the patient to health. Nothing more than that was done, and the patient has been mining coal ever since and is healthy and hearty.

Gastric or duodenal ulcer and gallbladder disease unquestionably often have their origin in the oral infections. In fact, I have come to look for this bit of evidence when considering a diagnosis of one of these conditions. Many cases simulate ulcers but on examination give negative findings. Most of these symptoms are due to hyperchlorhydria and respond well to clearing up of oral foci.

There are many cases of vague gastrointestinal symptoms, such as indigestion of an indefinite type and pain in the lower abdomen, that are due to gingival infection. These patients often come in thinking they have gallbladder trouble or chronic appendicitis. When the gingival infection is cleared up, the symptoms disappear.

Visceroptosis is one of the coincidental findings. You will be impressed with the frequency of oral foci in these cases,

and successful management necessitates the clearing up of these infections in addition to the treatment directed toward mechanical correction of the ptosed organs and building up of the general condition.

The relationship between essential, malignant hypertension and oral foci of infection is not quite clear, but this we do know, that removal of the infection does not promise the patient very much. Whatever is to be accomplished in this field must be of a prophylactic nature.

Finally, it has been shown by Logan, Rosenow and his colleagues at the Mayo Clinic that ulcerative colitis is a metastatic lesion from a focus of infection and that it responds well to clearing up of the initial cause and the use of autogenous vaccine. Prior to this time, this disease had been one of the most refractile to all forms of treatment. I have found also that mercurochrome given intravenously, in a dose of 10 c.c. of a 1 per cent solution, is of great value in some of these cases.

SUMMARY

This paper is merely a brief on the subject of clinical manifestations of oral foci of infection. The conclusions which I have drawn have been reached after eight years' observation in a general hospital with nearly 3,500 new admissions each year, about one-half of which are on the medical and dental services. A number of cases, differing widely in their symptoms, have been included to show some of the possibilities such as arthritis, acute rheumatic fever, subacute bacterial endocarditis, nonspecific aortitis, maxillary sinus infections with all the symptoms that go with it, peptic ulcer, gallbladder disease, neurasthenic states, toxic goiter and fever of unexplained origin. I have tried to make a point of the fact that complete and early removal of all oral foci will probably prevent most of the foregoing diseases and possibly many others of a less definite nature. A cure can often not be promised after permanent change has taken place in the diseased part, but elimination of the oral focus will often relieve symptoms and cause a return to health in many apparently hopeless cases.

DISCUSSION

C. H. Burmeister, Cincinnati, Ohio: Dr. Ervin states that no physician can give his patient the best care without the aid of a competent dental consultant. The truth of this statement is emphasized by the results obtained not only in Dr. Ervin's cases, but in those of internists throughout the country. That the internist, or physician, must recognize symptoms that point to focal infection is paramount. Many members of the medical and the dental profession do not yet realize the extent of mouth infection and its effect on general health, refusing to accept the reports of organized research workers. That the dental consultant be especially trained in oral diagnosis and treatment is an absolute necessity if the welfare of the patient is to be considered. Many times, a patient is referred to a dentist for complete mouth examination, and the examination is made with a mouth mirror and an explorer. If roentgenograms are taken, in many cases they are not properly interpreted or the dentist may not appreciate the relation of oral infection to systemic disease, and therefore, many teeth which should be condemned are saved. Let me emphasize here the value, from the preventive standpoint, of periodical roentgenray examination of the mouth, which, correctly interpreted, will do much toward the elimination of oral foci. The medical and dental profession are beginning to realize the results of chronic infections which have their foci in the mouth. Foci are found elsewhere in the body, but they do not enter into this discussion today. In cases that have not shown improvement after the removal of oral foci, the infection was probably checked too late or was not completely eliminated, and we must realize that the

removal of oral foci is not a cure for all diseases, but has value only in its proper place. Dr. Ervin has tried to make the point that complete and early removal of all oral foci will probably be an important factor in the disease conditions illustrated by him, but that a cure cannot be promised, especially after change has taken place in the diseased parts. I cannot let this opportunity pass without emphasizing what Dr. Ervin has said in regard to the value of regular combined meetings of the medical and dental professions. Cooperation of the two professions will help in working out many perplexing problems regarding focal infection.

Dr. Ervin (closing): Not infrequently, I see a patient with arthritis of an infectious type, perhaps of two or three years' duration. He may have been treated by a dozen men, but when I ask "What have you done to get rid of your rheumatism?" it is astounding how often absolutely nothing has been done except treating with pills, etc., without any attempt to remove the cause. There are too many of our medical men who are trying to practice without a dental consultant. It cannot be done, gentlemen. You can no more practice internal medicine today without a dental consultant than without the roentgen-ray. You can make a diagnosis of gall stones and ulcer in a high percentage of cases on the history alone, but you cannot remove the oral foci unless you have a consultant who is alert and willing to cooperate with you. We are going to see a big change within the next ten years. The dentist will become just as important a consultant when some member of the community loses his health as is the physician. Of course, his greatest field is going to be that of prophylaxis.

SILICATES*

By E. J. C. SMITH, D.D.S., West Hampton Beach, N. Y.

NO doubt, no material, not even amalgam, is so abused, as the silicates. Day after day, patients present themselves at my office with mouths hideous with specimens of the silicate filling at its worst: stained, checked, crumbly, chalky, discolored, with "flea bitten" margins and what not. And I might here pause to admit that some of them I placed myself in years past.

But looking at the reverse of this picture: I know many silicate fillings that have been standing and preserving tooth structure perfectly for a long period of years, that still match so perfectly that they are hard to detect even when pointed out. These were placed with a chain of perfect links as regards technic, a chain that is fairly long and each link of which must be well forged or failure will result.

The dental profession to date has discovered no perfect filling material. All metals lack perfection in that they are sensitive to thermal change. Also they all are failures as far as esthetics is concerned. All porcelains and silicates that match the tooth structure well lack strength or permanency, or both.

In a word, the filling materials that look best and are desirable as being insensible to thermal change, are weak or brittle, or both, while those that are

*Read before the Section on Operative Dentistry, Materia Medica and Therapeutics at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 22, 1928.

strong enough to be permanent do not look well; and all have the undesirable quality of being good conductors.

So it appears that all present day filling materials are weak on some points, and no one material can be best for any and all cavities. Practically the whole profession agree that the gold inlay cannot be excelled for the typical mesio-clusodistal restoration in bicuspid or molar; also that probably amalgam is most practical for occlusal cavities in third molars. I state that, likewise, the best grade of silicate, used with the proper technic, will be found equally serviceable in a large class of cavities.

Most typical of these is the simple proximal filling as placed in any of the upper six anteriors. In fact, here, more than in any other place, I firmly believe that this same grade of silicate so placed will attain a result more nearly perfect than will any other material in any cavity.

And by this I do not mean that this is the only place I use the silicates. With care, they can be used in other well chosen locations. But a silicate should not be used anywhere without due knowledge of its physical character.

TECHNIC

First, choose the make of material that you wish to use. Go over the claims of the various manufacturers carefully. There are only four, or at most five, well known makes of silicates on the market in this country. I was well pleased at the spirit of the chief chemist of one of the companies making silicates when, in a letter received the other day, he, in answer to some of my questions, agreed that other makes of silicates than his would do good work. They are all more or less alike chemically as far as I have been able to ascertain.

Study the directions of the maker of the one chosen carefully. Remember he wants the material to be a success, and to this end, two or three manufacturers have done a great deal of research work, the benefit of which is yours for the asking. The consistency of the mix seems to be the main point of difference and, for that reason, I urge again the careful review of all literature of the manufacturer, for anything that I say here will be only to emphasize or supplement their directions.

The powder of all makes is made by grinding and bolting many times through an exceedingly fine mesh a porcelain made by fusing together a refined silicate of calcium and aluminum, modified by the addition of coloring and other substances. The details of these procedures, all more or less secret with the manufacturers, are highly technical.

The liquid is a hydrated aluminophosphoric acid, or, in simple terms, a hydrochloric acid in which the hydrogen has been replaced by aluminum and to which a suitable amount of water has been added. The last procedure, from our point of view, is the most important part of the whole chemistry of this material, for that proper amount of water must be conserved, both from losses by evaporation or additions in any way, or certain failure will result.

The point that I wish to stress is that the silicates are said by many to be soluble in some mouths. This I shall attempt to disprove both clinically and chemically.

In the most careful chemical tests, the best grades of silicates will withstand mild organic acids as well or better in the laboratory than will good tooth enamel. Clinically, the most careful

tests in mouths that seem the worst offenders fail to demonstrate any great organic difference in the acidity of the saliva. In fact, it is reported that the hydrogen-ion concentration of saliva is, for an organic fluid, remarkably constant. These facts, coupled with the further fact that I, as well as others, have, with due care, replaced badly dissolved silicates with fillings that proved insoluble, lead me to feel that such soluble fillings are entirely the result of poor technic and not the basic fault of the material itself.

Thus, I maintain that, when the amount of work has been done by our profession on this material that has been done from the standpoint of careful research on such fillings, for instance, as the gold inlay, present-day criticism will be silenced, and a silicate technic will be developed that will render this material as fine for its type of cavity as is the inlay for its own sphere.

Those pitfalls in technic that are the common cause of this solubility may be outlined as follows:

First, there is the cavity. Remember that absolute dryness is positively essential for a good silicate filling; that without this, it will never hold under gum tissue; that it is not particularly adapted to stand the stress of mastication, and that it must be so placed that the application of matrix pressure during the period of initial set is possible.

The matrix is most important. Without it, I find good work impossible. I cannot pat in or smear in a silicate in any cavity, let it harden and polish to shape, and get satisfactory results.

These matrices are entirely different from those used for amalgam and have an entirely different purpose. Celluloid in various forms is the best material. This comes as strips, crown forms, facing forms, etc. The strips are used for simple proximal fillings. The crown forms, or rather a section of them, are trimmed to fit the margins of any cavity possible and also sometimes for whole silicate crowns or tips. The facing forms are used for replacing broken pin facings on bridges. If none of these can be made to fit, the cavity, after proper preparation, should be filled with a temporary material, trimmed to the exact shape wanted in the filling. After lubricating the surface with cocoa butter, we take an impression of the filled cavity in a button of compound and use this for the matrix. Only the briefest suggestions are given, for lack of time. Do not attempt a silicate filling without some form of matrix having a polished surface, having the contour wished for in the finished cavity, or flexible and easily bent, and held to the desired contour by the fingers during the initial set.

Preparation of the cavities is not difficult. They should be retentive, with square margins. Beveled margins mean chipped out and stained edges after a few weeks' service. Also beware of thin walls, being sure to remove all weak overhanging margins.

The powder of all silicates is so hard and abrasive that steel instruments wear off enough during mixing to color the fillings to a surprising degree later. Therefore, nothing but an agate spatula or one of the metals recommended by the manufacturer of the silicate you are using should be employed either for the mixture or later in inserting the filling. A good agate spatula cannot be excelled for the mixing.

The silicates, when first placed on the market years ago, received a bad reputation because they undoubtedly killed nerves. Then, being made of

crude natural minerals, they, or at least some of them, contained considerable free arsenic, a constituent of these natural minerals. Now, they are made from carefully selected materials, and no silicate, when properly handled, will cause death of the pulp.

All cavities that are at all deep should be lined with one of the varnishes provided for this purpose. All traces of this should be removed from the margins by a fresh chiseling, for, if left there, it will later cause a leak.

The shade is obtained when the tooth is wet. All manufacturers send out a shade guide for their own material and, by various combinations, any ordinary tooth shade can be matched. Color is one of the strong points in favor of the silicates. Indeed, it is hard to find a silicate filling when it is properly placed and of the proper color.

Having carried out all these instructions, and with the cavity ready and dry, I care not by what method, but dry with a dryness that can be held for at least five minutes, we then, and not before, take liquid and powder on the slab. This is done at the last minute to conserve the moisture in the liquid from evaporation. Bottles are restoppered at once and kept clean and uncontaminated.

Not over a minute and a half can be taken for mixing and slightly less time is much better. The manufacturer's directions must be consistently followed. Too thin a mixture means a soluble filling, owing to uncombined liquid in the mass; while too thick a mixture is equally bad, meaning a chalky mass impossible to pack tightly and full of crevices and cracks.

Transfer it quickly to the cavity, a small portion first, then a slight excess over the full amount required. Place the matrix and pull or force it to the margins, squeezing out the excess. Hold firmly to exert mild pressure on the mass of the filling for at least three minutes. This is the most important thing in the whole process. Pressure seems to make a much more dense and translucent filling. Do not burnish or pat the surface, for a glaze is desired under the matrix, from its polished surface and not from excess liquid brought to the surface by agitation.

After the three minutes' initial setting, carefully remove the matrix, being sure that the filling remains intact and in place. Quickly coat the surface of the filling with cocoa butter, taking care not to use excess heat. Let stand for a further ten minutes and then polish, if the case must be finished at the same setting. It is far better to coat with one of the varnishes on the market for that purpose and finish at a later setting.

If the idea of a matrix fitting fairly accurately to the margins has been followed, little cutting down will be necessary. The excess should come off easily. Where necessary, discs or fine stones well lubricated are used to cut down to margins. Polishing is done with fine felt or leather wheels and one of the extra fine dental polishes on the market. To avoid generating heat, all rapidly revolving tools are kept either wet or lubricated. The whole idea of the matrix is to polish as little as possible, but rather to leave that dense polished surface that faces this matrix with as little cutting back as possible.

Silicates can be used in many other ways than in the simple filling. After mastering the technic so that a dense translucent insoluble mass can be obtained at all times, one can attempt much more ambitious uses with considerable success. Silicate jackets are a

great help to tide over the embarrassing period while we are building a baked porcelain jacket. I have in place several silicate shell crowns that have lasted a term of years. They are made with the celluloid crown forms trimmed to fit the case.

Then, too, with the celluloid facing forms, a broken pin facing can be replaced, so that, unless the backing is weak and flexible, they prove very durable. There is a beautiful silicate cementing medium on the market which, in what experience I have had with it, seems to show up well, but on which I do not feel like passing full judgment until I have observed it for a longer period of time.

"To those that believe in prophylactic Odontomy, be it known that silicate cement is the prophylactic filling par excellence."[1] This is from an article, the whole of which I urge you to read. Briefly, the author refers to filling the narrow noncarious fissures in children's molars for prevention of decay, so common in these grooves, according to the teaching of Thaddeus P. Hyatt. You will note that the author is one of the many that take it for granted that the silicates are soluble in some mouths, or at least so it appears from this article.

SUMMARY

The important points for a translucent, dense, insoluble filling are:

1. Employment of the best silicate and proper care to preserve its original condition.
2. Proper instruments.
3. Absolute dryness.
4. A quickly made mix of the proper consistency.
5. Maintenance of matrix pressure during the initial three-minute setting.
6. Protection from moisture while hardening and care in polishing.

If these major points and some other minor ones are given careful attention your silicate technic will improve until you find yourself proud to show your work, not only to your patients, but to any member of the profession.

1. Ottolengui, R.: Dent. Items Int. Quart. Rev., April, 1928.

DISCUSSION

R. P. Thomas, Louisville, Ky.: Dr. Smith's insistence that we master the manipulation, insertion and finishing of the silicate filling material is to be commended. He informs us that this filling material is to be commended. He informs us that this filling is a chain of many links, the final result being as good as the weakest link. I wish to concur heartily in that opinion. I also wish to stress the importance of absolute dryness being maintained throughout and of the application of the matrix, because condensation is just as important with the silicates as with any other filling material at our disposal. No matter how well we master the silicate technic, no matter how minutely we carry out each detailed step, the question of temperature has an important bearing or influence on the finished product. We are told that the silicate mix should be at a temperature of about 65 F., and then it is immediately placed into a mouth normally of 98 F. Dr. Smith states that the silicate filling material is not soluble; that laboratory tests have shown that silicates withstand the solubility test as well if not better than the enamel of the tooth. I have long suspected and wondered if the frequent replacement of the silicate filling may not be due in part to the failure of that material to resist attrition. I believe clinical evidence will show that approximal cavities in the anterior teeth of the upper arch will function with longer service than similar cavities in the lower arch. Could this not be due to the fact that the lower teeth are subjected to a more frequent forcing of abrasive substances through the interproximal spaces? It has been noted that where the silicate and gold inlay, commonly called the window inlay, have been used in combination to restore point angles, this type of silicate restoration will remain intact over a period of years

without replacement, owing, in my opinion, to the fact that the interproximal wear is exerted more on the gold frame work than on the silicate. Can the silicate fillings, which maintained their original contour and color over a period of years, be accepted as a criterion for the majority; especially, since there is clinical evidence that the majority have not fared so well? In a paper read by Dr. Black in Detroit last year, the statement was made that "the average life of the silicious cement filling is probably less than two years, during which period a good contact is not maintained."[2] I do not agree with Dr. Smith that the silicates have no destructive effect on the pulp. If such is the case, why line the cavity, and especially since the material is a nonconductor? It is my understanding that the basic ingredient of the silicate liquid is phosphoric acid, which does not coagulate albumin as do most mineral acids; and, therefore, does not, by coagulation, limit itself by the interposition of a coagulated albuminous film between the live pulp on the one hand and the silicate filling on the other. Silicate fillings do not set completely for several days, and thus an opportunity for absorption of phosphoric acid over that period of time is presented. Free phosphoric acid must exist; otherwise, the setting process could not continue, and we might say that all unprotected pulps are endangered during the setting process. Experience has shown that silicate fillings will give better service over a longer period of time if the glaze produced in the setting process is left intact and not disturbed by polishing. There is a technic for this procedure with the combination gold inlay and silicate, but I have seen none for the simpler form of cavities.

J. H. Phillips, Nashville, Tenn.: We hear more about the shortcomings of silicate cement than we do about its good qualities. It is usually criticized in a paper written primarily on another subject, or it is shown at poor advantage in comparison with other filling materials. The average dentist, and I mean good operators, using it day after day, finds ample confirmation of the widespread disappointment in the material. Wherever the cause may be, whether in the material itself or in the technic, practical results are far from being in harmony with the claims of the silicate cement makers. While many of us are condemning it as a material for filling teeth, looking upon it as a sort of usurper of gold foil's rightful place, it is really refreshing to have a man come to the rescue, as it were, a man who believes in it to such an extent that he writes as an enthusiast. Attention is challenged when a man of Dr. Smith's type characterizes results as "wonderful," and refers to properly made silicate fillings as "insoluble" and "permanent." Greater claims could not be advanced by the manufacturers themselves. Notwithstanding the almost universal disappointment referred to before, there may be something really worth while in the silicates after all, even though the testimony of an expert or specialist is required to bring it to light. In an effort to determine the practical value of any filling material, it is manifestly unfair to ignore certain basic principles in technic. Even gold foil is a failure if the principles of its manipulation are not faithfully carried out. The same is true of amalgam and inlays, both gold and porcelain. The cements, including the silicates, attain their maximum efficiency only when the technic is followed with great care. Dr. Smith rests his case, so to speak, on silicates here, and I find myself in hearty agreement with him, although my experience and observation will not permit me to hold with him as to results. I am far from regarding the silicate filling as "wonderful" even in the most favorable cases with technic followed to the letter. I cannot use higher terms of praise than fair or pleasing. The belief that the silicates undergo a slow disintegration in the mouth is still with me. Fillings may be placed in Class 3 cavities, with contacts properly restored and esthetic demands fully met, only to cause disappointment later on. In what does this disappointment consist? Loss of contacts through disintegration or abrasion or both, and recurrence of decay at the gingival margins. These together constitute a menace to the health of the interdental tissues; and we all know that if the interdental space is not maintained, this tissue is crowded and irritated, and the door is opened to infection. As to the matter of adaptation to cavity walls, much is yet to be desired. The danger to pulps seems to have been practically eliminated. If the rank and file of us are making unsatisfactory

2. Black, A. D.: Progress in Operative Dentistry in Recent Years, J.A.D.A., 15: 1187 (July) 1928.

silicate filling through faulty technic, the sooner this fact is driven home, the better for our patients. The matter should be threshed out in the laboratories of some of our great universities. Perhaps the manufacturers of the silicates would welcome more of this, and would lend every possible aid through their research departments. Something should be done without delay either to justify or to condemn the scrapping of our gold pluggers to make way for the agate spatula.

E. J. C. Smith (closing): I agree with Dr. Thomas on the matter of temperature, but, as I have stated, the manufacturers have done a great deal of work on just this point and have designed this material to be mixed at 65 or 70 F. Thus, if mixed at body temperature, it will be chalky, porous and so slow setting as to be impossible to manipulate. As to solubility and Dr. Black's statement that the average life is but two years, I hardly believe that the average is as low as that, but my whole plea is that fillings put in by the proper technic will be well above this average of durability. I have been amazed at the difference between the amount of gold showing in patients' mouths here and in the East. I practice in a large summer resort adjacent to New York City and so see some of the best work in that part of the country. My patients absolutely refuse gold where it will show, and so I have to offer something having better aesthetic qualities. Insertion of baked porcelain is not easy in certain proximal cavities; and so this work on the silicates. I would ask my hearers to remember the disfavor visited upon amalgam until the very able work of G. V. Black. I see no reason why the silicates cannot be perfected when the amount of work has been done on them from the standpoint of deep research as Dr. Black did on amalgam. Who is the man of science who will do this work and perfect this material and its technic so that good work can be done with it consistently?

DETERMINING TEMPERATURE OF GOLD AND ITS ALLOYS AT TIME OF CASTING*

By ALFRED L. WILKES, D.D.S., Los Angeles, Calif.

I HAVE brought for your consideration something original, as far as I know, and a problem on which I have been working for several years. It interferes with no man's casting technic, but stands out as an important factor in the casting of gold and its alloys.

There have been many attempts at the standardization of inlay and casting technic, and what I have seen the last six months leads me to believe that perfection is not far distant.

In all the various technics, the technicians have been careful to state that the gold or alloys should be just the right heat when casting, and they have undoubtedly been right. We will all agree on that.

I began to wonder why some one had not given us a definite means of determining the heat of gold in casting, when so much emphasis had been laid upon this part of the process. Why had not someone done something about it? At last, I started to work on this one phase of the casting process, about which we, as dentists, know very little and would not be able to learn more if we con-

*Read before the Section on Partial Denture Prosthesis at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 23, 1928.

tinued to guess, for by guessing we can prove nothing.

Anyone could make almost any statement about the casting of the alloys as regards temperature. We could not prove that he was wrong and he could not prove that he was right; so there we stood.

Correspondence with gold manufacturers has not been encouraging, even though they have given the casting ranges for their alloys. Why have they given us the melting ranges at all when we had no means of ascertaining them when casting?

When the porcelain manufacturer tells us to glaze at 2,460 F., he knows that he is telling us something that we can do. How about the gold alloys?

To give to the dental profession an accurate means by which to determine when they have arrived at the temperatures or so-called melting ranges, as given out by gold manufacturers, to obtain the best results from their alloys is my purpose at present, and if I can show nothing more than this I will at least feel that some good has been accomplished.

Do not think that I consider this the one and only important step in the standardization of inlay technic; but I do consider it the one that has called forth many remarks, but has received little attention as regards accuracy, and I contend that inlay or casting technic is not scientifically standardized until we, who attempt to be teachers, cannot only tell those who come to us the temperatures at which the various alloys should be cast, but also show them that there is a positive and accurate means by which to determine these temperatures, which is brought about by the application of the pyrometer and thermocouple to the casting machine.

Can you imagine anything more ridiculous than to tell a man that, to get the best results, he should cast a certain alloy at 1,900 F., or any other temperature for that matter, when we absolutely know that no one has known at what temperatures he has been casting any of his inlays?

This appliance also permits us to determine the fusing or melting temperature of any alloy immediately by observation of the latent heat.

I shall now give a résumé on gold and some of its alloys; in their behavior under different degrees of heat, and as to their various physical properties.

The ancients were attracted by the beautiful color, the brilliant luster and the indestructibility of gold, and they spared no pains in the endeavor to acquire it. In the Code of Menes, who reigned in Egypt 3,600 years before Christ, or about 2,000 years before Moses, the ratio of the value between gold and silver is mentioned, one part of gold being declared equal in value to two and one-half parts of silver; and it is therefore clear that the extraction of both metals from the deposits containing them must have been carried on before that time.

In ancient times, gold appears to have been mainly derived from India, and that country continued to supply most of the gold used in Europe until the discovery of America by Columbus.

The luster of fine gold has given rise to most of the words which are used to denote it in different languages. The word gold is probably connected with the Sanskrit word *julita,* which is derived from the verb *juval,* meaning "to shine." It is the only metal which is yellow when in mass and in a state of

purity. Impurities greatly modify this color, small quantities of silver lowering the tint, while copper raises it. Malleability and ductibility are possessed by gold at all temperatures to a far higher degree than by any other metal. A single grain of gold can be drawn into a wire over 500 feet in length, and can be beaten into leaves not more than one-three hundred thousandth inch in thickness.

The hardness of gold lies between that of aluminum and that of silver, corresponding to the number 979 in Bottone's scale, in which the diamond occupies the position of 3,010.

The purest gold obtainable has a tenacity of 7 tons per square inch and an elongation of 30.8 per cent, but the presence of as little as one-two thousandths of other elements, especially bismuth, tellurium and other metals with high atomic volumes, greatly lowers these constants, as well as the malleability and ductibility of the metal, while its hardness is increased. Gold containing one-two thousandth of bismuth can almost be crumbled in the fingers. The specific gravity of gold when precipitated from solution by oxalic acid is 19.49. When cast, it varies from 19.29 to 19.37, but this can be raised by compression to over 19.48.

On heating, gold can be welded like iron, below the point of fusion, and finely divided gold agglomerates on heating without being subjected to pressure. Pressure alone is also sufficient to make gold dust cohere, while a true flow of the particles of gold can be induced in the pure metal and some of its alloys. Gold fuses, after passing through a pasty stage, to a clear cherry red under proper lights. Just below the fusing point of copper and much above that of silver, the metal expands considerably on fusing and contracts again on solidifying. This can be easily noticed by fusing gold in a bottle-neck crucible.

The boiling point of pure gold has not been determined. Calculated to Wiebe's formula, it would be about 2,240 C., or nearly 500 degrees above the melting point of platinum. Contrary to the belief of the older experimenters, it is sensibly volatile in air at far lower temperatures. Homburg gilded in the focus of a burning mirror in 1778, and St. Claire Deville volatilized and again condensed gold when melting it with platinum. The rapid volatilization of gold when heated by an ordinary blowpipe was first proved in 1802 by Dr. Robert Hare of Philadelphia, a purple stain being thus produced on bone ash in a few seconds.

Rose states that a piece of gold weighing 0.5 gm. loses half its weight in an hour if heated on a cupel to a temperature of 1,300 C. Alloys of copper and gold disappear much more rapidly.

The electrical conductivity of gold is 76.7 and its thermal conductivity 60.0, as compared to silver (electrical and thermal conductivity each 100.0). Its atomic weight is believed to be about 196.8. The atomic volume of gold is 10.2. In overheating, no doubt, most of the gold passes off as spray, but perhaps part of the loss may be due to rapid volatilization and could not be correctly described as mechanical loss. The volatility of gold, both when pure and when alloyed with silver and copper, has been investigated by Napier, who found that an alloy of 100 parts of gold to 12 parts of copper, kept for six hours at a temperature just high enough to keep it melted, lost 0.234 per cent of its gold contents, and at the highest temperature obtainable in an assay muffle, 0.8 per

cent was lost in six hours. An increase in the amount of copper present caused an increase in the loss of gold. Rose states that, in the simple operation of pouring 30 pounds of gold-copper alloy from a graphite crucible into molds, fumes were given off, of which the part condensed in a wet glass breaker held above the crucible contained 4.5 grains of gold. Napier also found that gold does not appear to volatilize so readily when alloyed with silver only as when copper is also present.

According to Rose, of the British Royal Mint, the loss of gold on heating the pure metal rises with the temperatures, being four times as great at 2,220 F. as at 2,100 F. Platinum seems to have a very slight effect in increasing the volatility of gold. Tellurium causes the greatest loss, gold containing 5 per cent of tellurium losing from 16.5 to 39.5 parts in 1,000 by volatilization per hour at a temperature of 2,260 F., which is 315 F. above the melting point of gold.

It has been shown by Edward Matthey that in gold ingots containing members of the platinum group, when cooled from a state of fusion, an alloy rich in the more fusible element (gold) falls out first, driving the less fusible constituent (platinum) to the center. Thus, the assay of an outside cut of such an ingot gives a result too high in gold by several per cent.

In view of these facts, I have for several years been of the opinion that if we could devise some means by which we could tell accurately the temperature at which we are casting our various gold alloys, it might be a great aid in governing and checking our casting technic. Our gold manufacturers have given us casting temperatures for their various casting alloys, but they have given us no means of ascertaining when we have arrived at the proper temperatures. How many of us would attempt to fuse porcelain without the aid of the pyrometer and thermocouple? If a man were to ask you at what temperature you cast a certain alloy, what would you tell him? But you can tell him at what temperature you fuse a certain brand of procelain. Light oxids, etc., I have found, change the appearance of molten gold alloys to a marked degree, which is very deceptive.

In the industrial arts, such as baking of clays, enamels and porcelains, the fusing of metals in foundries and casting of steel, the temperatures are at all times indicated by some means such as the pyrometer and thermocouple. I do not claim this as an original invention, but simply an application to the art of casting gold and its alloys.

We all know that, at times, our castings come out better than at other times. There must be a reason for this. When we get what we consider an exceptionally good casting, it would seem reasonable to assume that the various steps entering into this operation must have been correct. These steps might be known as: 1. Proper investment. 2. Painting wax pattern. 3. Proper manipulation of investment. 4. Proper wax elimination (and by this, a definite time and a definite heat). 5. Casting molds at a definite temperature. 6. Establishing a definite temperature of gold when casting.

It has been my opinion and also that of the general profession at large that a great deal of our trouble has been in our inability to know more about our gold as regards casting temperature.

In applying the thermocouple and

pyrometer to the casting of gold, it is at present necessary to use a casting machine of the type that permits of a fixed crucible in which the thermocouple may be permanently fixed so as to protrude up into and through the mass of molten metal and as near the center of the mass as possible. The thermocouple is composed of two wires which are fused together at the end, producing a bead. You will notice it in the oven of your porcelain furnace. These wires are necessarily composed of metal which is high fusing and will not melt at the temperature of the material with which you are working. The couple, as we use it for high temperatures, is composed of one wire of platinum and one of 10 per cent iridioplatinum. These are connected to the pyrometer. On application of heat, a minute current of electricity passes from one to the other, the conductivity being different, owing to the fact that one contains 10 per cent iridioplatinum. The pyrometer registers this small current in degrees, both centigrade and Fahrenheit, and is constant, provided the balance of the thermocouple is not upset by becoming contaminated or amalgamated by other metal. This has been nicely taken care of by coating the couple, which protrudes up through and into the molten mass of gold in the crucible with alundum cement, which is capable of withstanding great heat without checking or melting, and will protect the couple from becoming amalgamated with the gold, which would otherwise upset the action of the thermocouple.

Any good grade of porcelain furnace pyrometer may be used. It is connected to the thermocouple that is set up in the crucible of the casting machine, as before described. A blowpipe can now be played into the crucible, to see if the pyrometer hand is active. If the pyrometer hand tends to go down, it is hooked up wrong, and the wires should be changed to the opposite poles, which will reverse its action and cause it to come up the scale.

The next step is correcting or checking the pyrometer to see whether or not it is indicating the correct heat. This rather interesting process is taken advantage of by using pure gold as a standard, which has the generally accepted fusing point of about 1,945 F., at which point it has absorbed its latent heat and has changed its physical properties from a solid to a liquid. Latent heat, a very interesting phenomenon, is beautifully demonstrated by the use of this contrivance. Any material, when undergoing a change from a solid to a liquid on application of heat, will, at the time this change begins to take place, remain at the same temperature until the entire mass has changed its physical state, and the heat that is applied during this change is absorbed as energy and does not raise the temperature. It will be noted that the pyrometer hand will pause noticeably at this point, and will again continue on up after the change has taken place, provided the heat is continued. If the heat is carried beyond the melting point (and by the melting point, I mean when the pyrometer hand starts up again after the pause at latent heat and the blowpipe is removed), it will be noticed that the pyrometer hand will fall rapidly until the gold begins to solidify, at which point it will again pause at about the same place where it paused on the road up, until the mass is completely solidified, giving off its latent heat; after which the pyrometer hand will again continue rapidly down the scale.

Now, if the pyrometer hand does not register 1,945 with pure gold, at the

latent heat period, it should be recalibrated to so indicate. This is done by changing the resistance in the pyrometer coil so that it will read 1,945 at latent heat, and once it has been balanced up properly, it will give no further trouble, provided nothing happens to the couple in the way of contamination.

It will be interesting now to take the various alloys and find their points of fusion.

Arthur W. Lufkin, of Hollywood, and I have carried through a series of castings from a simple Class II cavity cut in a steel die, the steel die being deemed more accurate and capable of revealing the actual facts as to contraction or any distortion.

Taggart's investment was used, spatulated in a mechanical spatulator of the rubber bowl type. Wax was eliminated by being placed in the automatic electric wax eliminator devised by me, which went from room temperature to 200 F. for twenty minutes, and automatically stepped the heat up from 200 F. to 400 F. for 30 minutes, at which it was discontinued. The time and temperature can be changed in this device to suit the operator. We have used these above mentioned in each case.

Great care has been exercised in the various steps leading up to the actual casting, every step being carried out the same in each case as nearly as possible, to produce each mold the same, the molds all being cast at 200 F., in carbonized molds.

This series of castings was carried through a wide range of temperature. Each individual casting has a label on which is marked the temperature at which it was cast. The range in this series runs from 1,770 to 2,640 F., not over forty degrees difference existing between any castings, and between some, less. Good castings were obtained at 1,770 F. up to 2,170 F., at which time there was evidence of the investment becoming fused by the alloy, producing rougher castings and becoming more difficult to pickle clean, even by the aid of hydrofluoric acid.

We have found that it will take a great deal of time to go through the various fields of the experiments that are now opened to us, and, having a limited time, we have taken up this one series of castings, with the same technic throughout, the only changing factor being the difference in the heat of the alloys.

It might be of interest to know that in the casting made at 1,770 F., at which point it was hardly fused, a large part of the button remained in the crucible, and the fused outside portion left the unfused portion and resulted in a very nice casting.

I have heated one alloy that fuses at from 1,800 to 2,450 F., and found, by placing it again in the crucible and observing the latent heat period, that the fusing point had been raised 100 F., which undoubtedly shows that copper has been thrown out, as it is the metal in this case that lowers the fusing point of gold. This undoubtedly proves that overheating upsets the alloy balance and changes the physical properties of the resulting product, especially in alloys containing high copper contents.

CONCLUSION

I intend to run a series of castings in cold molds which have been boiled out, leaving no carbon, to test various brands of investment, with and without carbon, to determine which will permit of the highest heat without distortion or fusing of the investment to the gold, and at

which points this takes place in each case; also, to run a series of castings of the various alloys, class metals, etc., to have tested the physical properties of the resulting castings at the various temperatures, and to determine if possible the effect of overheating on the resulting casting.

DISCUSSION

Merle W. Wilkinson, Santa Monica, Calif.: The progressive metallurgist or foundry man in the industries has eliminated a great deal of guesswork in the casting of metals and alloys through accurate measurements of melting and pouring temperatures. The advantages to be gained by this control are no longer supposition. Results have indicated that the temperature of the metal or alloy as it enters a mold is of vital importance in the control of its physical nature and adaptation. In the larger production foundries, where castings of variable size and shape are made from metallic alloys over a wide range of melting temperatures, the pyrometer finds its sphere of greatest usefulness. Large quantities of metal are involved and the temperature of the melted metal is determined by the insertion of a thermocouple directly into the melt. Accurate pyrometer readings replace personal judgment, and more consistently reliable temperature control results. This has its influence in quality and quantity of production through better castings and fewer failures. Long experience and constant practice aid the expert eye in judging a metal's temperature, and many good castings are made without the use of a pyrometer. But no doubt is attached to the value of temperature control in casting uniformity. Pyrometry has not yet lent itself to the casting of gold alloys in dentistry. Certain melting points and casting temperatures are set down for the various alloys as formulated in production. It is true that no definite means has been prescribed for attaining these exact temperatures nor do these figures count for much without this means of control. Nevertheless, they stand as advantageous to casting uniformity, and the problem becomes one of the development of a satisfactory means of measuring temperatures under ordinary dental casting practice. Until this means has been supplied, the human eye must be counted upon for a certain degree of accuracy. Judging of temperatures by sight involves a knowledge of two things, color and fluidity, these being manifestations of a metal's temperature when liquefied. Melting metals pass from a red to white with advancing temperature. The degree or intensity of this color is peculiar to each type of metal or alloy and differs greatly with any type if melted under variable light conditions. For example, if melted at night or on a dark cloudy day, there is a greater whiteness and brilliancy at a given temperature than at the same temperature on a bright clear day. This difference in appearance may lead to errors in judgment. Viscosity or its opposite, fluidity, in its varying degrees, is more or less a consequence of temperature change. Generally speaking, the hotter the metal, the more fluid; likewise, the colder, the more viscous. Fluid metal exhibits well known distinctive features: 1. It looks and feels thinner. 2. Its surfaces are not so rounded but lie flatter. 3. It is displaced more easily, that is, slight movements cause it to roll. 4. It flows faster, cleaner and easier. 5. Its dross and impurities separate readily. 6. It hugs walls of crucibles more closely but adheres to them less tenaciously. The degree of fluidity can be changed greatly by the addition of a flux, a viscous metal often becoming quite fluid on the addition of the flux. A lack of uniformity in a metal's fluidity may result through dissolved oxids and the presence of other impurities. This might be confusing in judging a metal's fluidity. Color and viscosity therefore give us our means of temperature control in dental casting. They are the thermocouple and pyrometer of the human eye. But why all this fuss about temperature control? Why is it essential to know the temperature at which a metal or alloy is being cast? This question has been ably presented by Dr. Wilkes in his paper. Through the adaptation of a thermocouple and pyrometer to a centrifugal type of casting machine, he has been able to make a number of test castings over a wide range of casting temperatures that are definitely known, allowing for some slight variations due to the slowness with which the needle of the pyrometer is activated and the rapidity at which the comparatively small amount of metal is brought to the desired casting fluidity. Dr. Wilkes presents a field which offers extensive investigation into the

effects produced in dental castings through underheating and overheating of the melted metal. We have at present a great deal of supposition. One would feel that temperature control is a desirable thing in dentistry just as much as it is in the melting and casting of brasses, bronzes, steel or any other type of alloy, for increased efficiency and uniformity of results. I have never yet read a digest on dental casting that did not contain the warning, "Do not overheat your gold." In these digests, no definite establishment of the resultant evils has been made. In fact, I have heard overheated gold blamed for a good many casting defects, more or less carelessly, and apparently with little knowledge or thought. It is not my purpose in this discussion to attempt the establishment of the evils which result from overheating for fear of placing myself in the same category. Temperature controls viscosity and fluidity. Effects produced through temperature must be produced principally through the degree of fluidity. It is not really temperature in itself then that causes these casting defects which are a part of the physical nature of the casting, but rather the fluidity of the metal produced by temperature. It would be normal to assume that the first effect of underfluidity would be incompleteness of castings; in other words, there is not sufficient fluidity to allow the metal to flow freely and completely fill the mold, giving rounded or incomplete edges to the cast. Underfluidity requires excessive pressure in casting. My observation has been that the best castings are made when the metal is just liquid and is cast under higher pressures. The effects of excessive temperatures, theoretically, are legion. The internal crystalline structure of a cast metal is governed largely by its rate of cooling and its time of solidification. Brittle castings without doubt result from overheating, because metals that are cast at high temperatures, during cooling, heat the mold so hot that the rate of cooling is retarded, resulting in a cast metal that is coarse grained, granular and weak. Tensile strength is greatly reduced by casting at high temperatures. For example, an alloy of copper and aluminum melted at 1,200 F. shows 20,000 pounds per square inch tensile strength in cast form. The same alloy cast at a temperature of 1,600 F., or 400 degrees higher, tested but 16,000 per square inch. Overheating causes roughness of castings, owing chiefly to the temperature of the incoming metal being sufficient to slag or fuse the lining of the mold. Overheating causes slightly higher shrinkage factors, since shrinkage has been stated as being a function of the temperature drop from casting temperature to solidification and then to ordinary temperatures. It has always been my belief that the greatest amount of shrinkage occurs from the casting temperature to solidification, rather than from solidification to ordinary temperatures. I do not think that the work of Dr. Wilkes has disproved this. It would be difficult indeed to distinguish a possible difference in shrinkage, which cannot be anything but slight, based upon the results of casting a small inlay. I do not believe that variations in shrinkage or contraction can be shown in casting a small inlay to fit a steel die. All gold alloys expand when melted and contract correspondingly when they cool, perhaps in varying degrees. There is either shrinkage or expansion through the pattern making, investing and burning out. The amount of metal shrinkage is small in comparison. Variations through overheating are still smaller and practically unmeasurable in small castings. Overheating and the production of castings of irregular shape and bulk cause unevenness of solidification and therefore variable internal structure. Development of internal gases which cause blow holes or pits in castings is promoted by overheating a metal or alloy. It seems advantageous to control the temperature of a melted metal as it enters a mold. In dentistry, it is vital not to overheat, but between what limits of temperature and over what range is allowable will govern the advantages to be gained in the use of a pyrometer. If the allowable range is but fifty degrees, a pyrometer is essential. If the range is from 300 to 400 degrees, the eye should be sufficient, if the metals used are clean and uniform melting. At least, there is no need for overheating. Pyrometry in this case is simply a control of carelessness. There is, of course, some advantage in this.

PROGNOSIS AND TREATMENT OF PULPLESS DECIDUOUS TEETH*

By W. R. ALVORD, D.D.S., Detroit, Mich.

THE kind of paper that I should like to read on the subject of the treatment of pulpless deciduous teeth would compare the points of view of many successful operators. This I cannot give to you, for the papers that I have chanced to read seem to cover only portions of the subject, and, where these views do touch on the same phase, they seem so varied and are so lacking in harmony that I cannot bring you much except the development of my own technic.

In 1903, I began seriously to consider ways and means to conserve and to treat deciduous teeth. It was a disheartening endeavor. The dental periodicals of that time had little to offer on the subject. My greatest help came from giving clinics on the crude methods that I was using. Usually, there were few who were interested and still fewer who would give any definite information. Mine was not the type of mind for research, but I persevered and finally worked out a technic that gave a fair measure of success.

Parents of that day expected to have dental care for their children gratis or at most to pay a quarter for an extraction. The repair of broken down deciduous teeth was rarely permitted. Certainly, no fee was allowed for filling, and the treatment of a pulpless deciduous tooth was out of the question. Publicity of health articles and advertisements of manufacturers have gradually changed conditions, till now dentistry for children is taking a place in the dental office.

From the use of iodized phenol as an antiseptic and chlorapercha and guttapercha points for canal filling, I progressed to formocresol with catgut and resin dissolved in ether. The catgut and resin were used in an effort to obtain a canal filling that would absorb with the root. The results were unsatisfactory, although I tried for two years, changing the solvents for the resin, believing that the theory was correct. The next effort was with oxpara. I then tried various and sundry so-called abscess cures and mixtures that no sane man would have used, till J. P. Buckley's formulas, put up by Lilly, were standardized. I made some progress with these. One day, I saw a dentist set a bridge with oil of cloves and zinc oxid. I wondered if the mixture would not do for filling deciduous canals. An old druggist in a country town told me powdered silver nitrate crystals when mixed with the zinc oxid would make the mixture set harder. It did, but gave me a bluish gray mix to which most parents objected, though it was really an advance and is the forerunner of my present technic.

*Read before the Section on Mouth Hygiene and Preventive Dentistry at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 22, 1928.

When Percy R. Howe of Boston showed me his work in reducing silver in pulpless teeth, I tried that. It has its merits.

In the fall of 1920, I was invited to work with a group of thirty men in an endeavor to find a technic for root canal work that would be scientifically correct, yet simple enough for the average man in general practice to use. At first, this group seemed entirely uninterested in the treatment of deciduous teeth. The problems presented were so trying that few operators cared to take the trouble to master a technic.

It was at this time that I came in contact with Thomas Bartholomew, who had recently moved to Detroit. I found that we had been working along the same line of procedure and had evolved almost exactly the same technic. We have both modified our technic and differ slightly, but I am under great obligation to Dr. Bartholomew for his generous cooperation and exchange of ideas.

About this time, I received further impetus from Phillip R. Thomas of Minneapolis. I do not know what Dr. Thomas' present technic is, but we did not agree at that time. A little later, Edouard M. Hall of Kansas City expressed his opinion of the work that Dr. Bartholomew and I were doing. He did not think much of it, and neither did Dr. Ottolengui of New York. Since they offered no constructive methods, I disregarded their criticism. Dr. Coolidge of Chicago was more charitable and gave genuine encouragement.

U. G. Rickert of Ann Arbor was most helpful in his discussions and later accomplished a definite step in the right direction. His formula for root canal filling is being successfully used. While Drs. Bartholomew and McBride use Rickert's technic with entire success, I have not been able to do so because, as I recently learned, they substitute iodin dissolved in glycerin for Rickert's liquid and add silver nitrate of the volume of half a kernel of wheat. I cannot comment on this procedure as the test of time only can give the answer.

Diagnosis is really the governing factor rather than the technic of treating and filling the canals and pulp chamber. With poor judgment in diagnosis, the finest technic will come to naught. And herein lies the most unsatisfactory feature of this paper. I feel that I can tell with some accuracy whether a tooth will respond to treatment, but I am at a loss to give an unerring guide to diagnosis.

Among the conditions to be weighed carefully are: (1) the general health of the child; (2) the dental development of the child; (3) the physical condition of the tooth; (4) the color of the adjacent soft tissue; (5) the translucency of the tooth structure, and (6) the color of the floor of the pulp chamber.

The first phase needs no comment. The dental development, or lack of it, should be noted. A diagnosis, otherwise favoring the retention of a tooth, must be altered if the period of future retention is too short. Teeth too badly broken down to be sensibly restored should not be retained. Soft tissue adjacent to the tooth should give evidence of an active blood supply. If, on transillumination, the tooth shows a cloudy area in the floor of the pulp chamber, prognosis is doubtful. Roentgenograms are unreliable, as a total lack of bone support may be shown, yet, on examination and percussion, the tooth may be found to be sufficiently firm to warrant retention.

Here let me define the term "pulpless" as used in this paper. I use the term as meaning "without a vital pulp."

TECHNIC

When treatment of a pulpless deciduous tooth is indicated, the following, with a few exceptions, is my routine procedure:

First Treatment.—Obtain access to the pulp chamber and remove the contents. Follow this procedure with thorough irrigation. Use tepid water followed by hexylresorcinol S. T. 37,[1] 50 per cent. Do not enter pulp canals at this time. Absorb the excess moisture from the pulp chamber. If the tooth is tender on percussion, do not seal. Place a lightly packed pledget of cotton with oil of cloves (excess expressed) in the chamber, if indicated. Dismiss the patient for twenty-four hours or so.

The cotton is placed to keep out food. The oil of cloves is used simply to penetrate the cotton fiber and retard fouling of the cotton. If the tooth is not noticeably tender, place the cotton pledget with fresh formocresol on the floor of the pulp chamber. The excess should be expressed by touching the pledget to a cotton roll. Seal for from twenty-four to forty-eight hours. From this point, no saliva should enter the tooth.

Second Treatment.—If the tooth is not sealed and tenderness is reduced, irrigate with tepid water followed by hexylresorcinol S. T. 37, 50 per cent, and seal in formocresol as outlined in the former treatment. I prefer a temporary cement to temporary filling for this purpose. If sealed, isolate, wash with iodin, mercurochrome or hexylresorcinol S. T. 37, 50 per cent, to cleanse the exterior. Dry, and remove seal and formocresol pack. Remove the contents of the pulp canals, being careful not to go to the point of sensation if it can be avoided. Our object is to remove infection, not to induct it into the tissues. Some care and judgment is needed here, but it is not too difficult to be practicable.

The next step is important. The canals should be wiped clean and as dry as possible with sterile absorbent paper or cotton points, care being observed that infection may not be forced into the surrounding tissue. I take this step before instrumentation of canals and again after instrumentation. It is absolutely necessary to obtain access to the canals so that they may be properly filled, but the canals can seldom be filled at this time. After absorbing any fluid contents of the canals, flush the pulp chamber with hexylresorcinol S. T. 37 undiluted, and absorb. Flush, and absorb the moisture from the chamber and canals five or six times. Then, place a pledget of formocresol (excess expressed) on the floor of the pulp chamber, but not in the canals, and seal for forty-eight hours.

Third Treatment.—The filling of the canals can usually be accomplished at this sitting. If another treatment for sterilization is indicated, proceed as in the second treatment. The field of operation must, of course, be cleansed before removing the dressing. If the third treatment does not prepare the canals for filling, further effort is usually futile.

All cavity preparation is done before the root canals are filled. It is imperative that no saliva enter the tooth after it is prepared, treated and ready for filling. In order to accomplish this, I make my cavity preparation at a previous sitting, and when I fill the canals, I place my cement base, place the matrix and complete the filling.

1. Hexylresorcinol S. T. 37 is a 1:1,000 solution of hexylresorcinol, surface tension 37 dynes per centimeter.

For filling the canals, I still use a mixture of zinc oxid, eugenol and silver nitrate. I place 1 minim of eugenol on the glass slab, then 2 minims apart from that. I have an instrument with which I have learned to place on the slab a volume of silver nitrate equal in size to the one minim of eugenol. The silver nitrate is placed to one side so that the mix of eugenol and zinc oxid can be made first and the silver nitrate added last. Zinc oxid is placed on the slab sufficient in volume to make a creamy mix with the eugenol. Prepare guttapercha or temporary filling.

Isolate the tooth, cleanse, remove dressing, absorb moisture, if any, from the canals, flush twice with hexylresorcinol S. T. 37 and absorb to dryness. I do not attempt to desiccate. I now mix zinc oxid into the 3 minims of eugenol to make a creamy mix and add the volume of silver nitrate. With a stubby smooth broach, convey this mix into the canals and pulp chamber, and with a pistonlike motion, pump the canal full. Now, place a pellet of softened guttapercha or temporary filling in the chamber and press the canal filling to the point of sensation. Trim or remove the guttapercha and wipe out the excess filling material. Prepare the cement base and fill the tooth. I think the filling is more durable with a cement base than with temporary filling.

Attempt to place the canal filling before the eugenol completely throws down the silver in the silver nitrate. This is why the silver nitrate is mixed in last. This may not be of vital importance, but I use the silver nitrate with the expectation of completing the reduction of the silver in the canal and chamber, but more particularly to render the canal filling more nearly impervious to moisture and harder and denser when set.

Edouard M. Hall of Kansas City, authority on the treatment and filling of pulpless permanent teeth, objects to this technic for deciduous pulpless teeth on the ground that "the filling in the canals would be absorbed and leave an open root end." I use this technic in order to have a canal filling that will absorb with the roots, and I am convinced that that is just what happens. In any case, the percentage of success is high and the failures are rare. Dr. Rickert, of Ann Arbor, objects to the use of formocresol on the ground that it is a tissue destroying agent. I am inclined to think that the conditions surrounding the root ends of deciduous teeth which cause their resorption may in part nullify that argument.

We never find granuloma on the root ends of deciduous teeth. We find a morbid growth in the bifurcations of deciduous molars, and, in my opinion, this influences the appearance of the floor of the pulp chamber. I referred to this appearance as one of the points of diagnosis. Dr. Carl Huber, histologist of the Medical Department of the University of Michigan, informs me that there is no difference in the histology of permanent and deciduous teeth; therefore, the difference is not histologic. I do not know what the difference is. I would like to see an authoritative paper on that point. I have listened with interest to a discussion between Drs. Hall, Coolidge and Girardot on the subject of overfilling the canals of pulpless permanent teeth, and while not capable of expressing an authoritative opinion on that subject, I offer an opinion on the overfilling of canals of deciduous teeth. When the filling material used will absorb as the roots absorb, I have been

unable to appreciate any ill-effect if the filling material passed beyond the root ends.

While this paper is supposed to treat of the procedure with nonvital pulps, I feel that I should state my position in those cases in which the pulps have some vitality. My experience in using arsenic as a devitalizing agent has been distressing in some cases. I do not know how to use arsenic in deciduous teeth so that I am sure of no ill-effect to the surrounding tissue. Hence, if I cannot cap the pulp and restore it to normal, I prefer to extract the tooth. The floor of the pulp chamber is so thin that, even though I may successfully seal in the treatment, I am liable to start trouble in the tissues in the bifurcation if I use arsenic. McBride uses a devitalizing fiber and has had little trouble.

Pressure anesthesia with procain is not often practicable, and the danger of pushing infection through the root ends is great. In my opinion, this procedure with children is rarely indicated.

There is no short cut in children's dentistry. If you are going to do this work, do it well. The canals in pulpless teeth must be entered and properly treated. Simply placing an antiseptic in the pulp chamber and filling the tooth is not to be tolerated. The results of careful work certainly are fruitful, and to have filled roots remain apparently healthy for four or five years is a reasonable expectation, provided the age of the patient is such that retention for that length of time is desired.

CONCLUSION

I wish to urge members of our profession to use every effort to teach sensible, efficient mouth care to children; to use all necessary care for thorough work, and then to write on the results so that we may all profit by their successes and failures.

Let us read and reread the editorial on dentistry for children in the June JOURNAL, by Dr. Johnson, and send in our reports to let him know that progress is being made.

1074 Maccabee Bldg.

DISCUSSION

W. C. McBride, Detroit, Mich.: I cannot let this opportunity go by without saying a word in defense of the pulpless teeth. In institutional procedures, this technic is of no value at all. One cannot treat pulpless teeth in institutions. But every one of us in our juvenile practice has patients with whom we have to utilize measures for the maintenance of pulpless deciduous teeth, and I talk only in that interest. Every one of us have patients who will appreciate the maintenance of deciduous teeth that have become pulpless, and we have had cases in which we would do almost anything to please the parent that would serve to keep these teeth in place. Therefore, I proceed somewhat after the fashion of Dr. Alvord, using the formocresol, and sealing in when the field is sterile a mixture of Rickert's root canal filling material. But instead of using the liquid of this paste, which makes the material rather stiff, we use a compound of iodin and glycerin. This is Dr. Rickert's own suggestion for deciduous teeth. We have found in going over our records for the past six years that, according to official record, 95 per cent of teeth so treated will respond and maintain themselves until the normal exfoliation period. Now you will understand that, in every office, in every practice, one's patients will become dissatisfied now and then, and go elsewhere, and will sometimes go to the dentist in general practice to have a tooth out if it has responded abnormally, so one cannot check these cases at all completely. But I would state, in all fairness to you and to myself, that at least 75 or 80 per cent of all teeth so treated will respond normally and can be maintained until the normal time for exfoliation. A word in defense of the pulpless tooth: It is unfair to extract every tooth that becomes pulpless. If you do that promiscuously, you

may as well give every patient a through ticket to the orthodontist, and you know that many people cannot stand the financial stress of orthodontic procedures. If you try this procedure as Dr. Alvord has outlined it, a procedure which is quite similar to my technic, you will find it very satisfactory. You can certainly use it to splendid advantage on some of your patients who appreciate this type of service. It cannot be used in institutional work.

C. L. Drain, Iowa City, Iowa: I am from an institution, and we devitalize teeth successfully in many cases. We do it practically as Dr. Alvord has outlined. The students do it. We are not successful in all cases. We are keeping a record of every case, both the roentgenograms and a card record. We attempt to have a roentgenogram taken every six months on these cases, and hope to be able, in two or three years, to have enough pathologic evidence after extraction to know just what we have done. We all know that we have an increase in heart disease mortality during childhood. I have wondered many times whether, in some of these deciduous teeth that we think we have successfully treated, we are sealing up some streptococci that are responsible for a fatal result. There is a great deal of work to be done and we know little about it. Have an open mind, work on the problem, record your results and report them.

FINDINGS IN STUDIES OF TOOTH DEVELOPMENT*

By W. G. SKILLEN, D.D.S., and EMIL MUELLER, D.D.S., M.S., Chicago, Ill.

SERIAL sections of young rats offer splendid material for the study of many interesting developmental problems. Frontal sections of the lower jaws of rats show the close topographic relationship between the lip and the organs of the jaw during early development.

In order that we may be able to visualize the actual shape of all the organs, it becomes absolutely necessary that we study the material in serial sections. The significance of the various structures becomes more apparent the more we study serial sections. In the study of development with only single specimens, it becomes easy to mistake different sections from the same series for different stages of development.

The accompanying photographs were taken from serial sections of the jaws of rats ranging in age from a week before birth to about three weeks after birth.

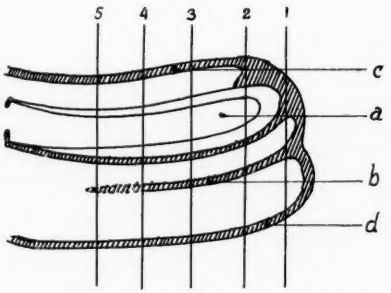


Fig. 1.—Diagram of the lower incisor of a rat, with the surrounding tissues. *a*, tooth; *b*, lip furrow band. Between lines *4* and *5*, corresponding to Figures 5 and 6, the lip furrow band is separated by the median raphe, indicated in the diagram by the broken line. *c*, mouth epithelium; *d*, epithelium of the outer surface of the lip.

*From the Research Department of the Northwestern University Dental School.

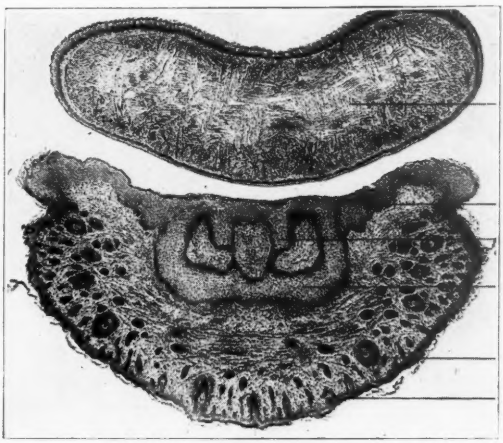


Fig. 2.—Frontal section of the head of a rat 1 day old. *a*, mouth epithelium; *b*, epithelium of the lip; *c*, hair follicles; *d*, lip furrow band; *e*, dental lamina; *f*, tongue.

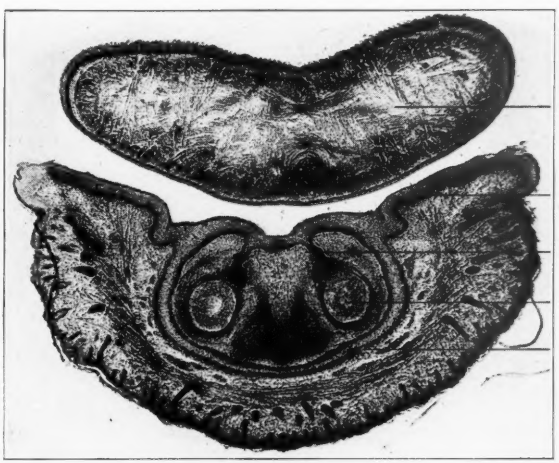


Fig. 3.—Section from rat (Fig. 2), further distally. *a*, incisors; *b*, mouth epithelium; *c*, dental lamina; *d*, lip furrow band; *e*, tongue.

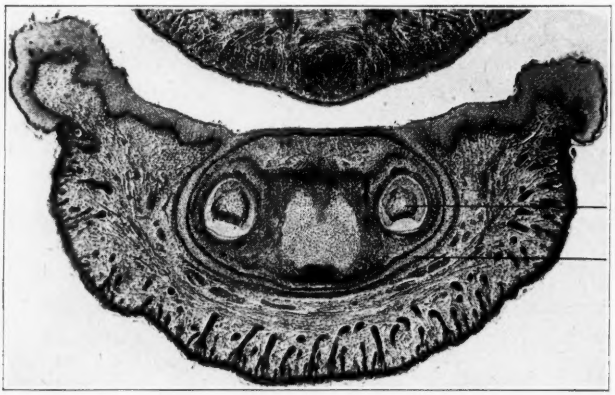


Fig. 4.—Section from a rat 4 days old. *a*, tooth; *b*, lip furrow band.

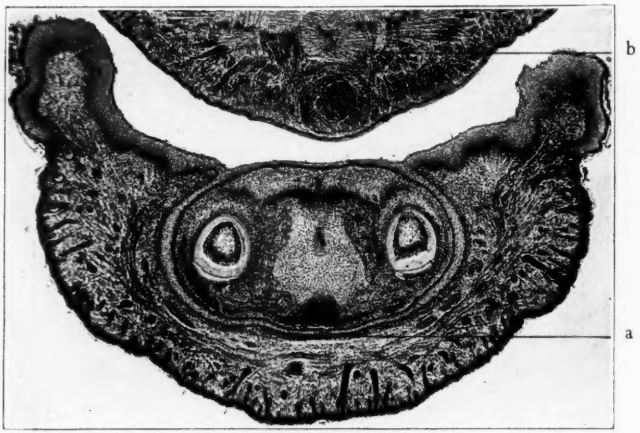


Fig. 5.—Section further distally, from rat (Fig. 4). *a*, separation of the lip furrow band, corresponding to the median raphe; *b*, tongue.

In Figure 1, there are indicated the different regions from which the sections photographed were taken. The vertical lines from one to five correspond to the five photomicrographs that will be presented a little later. In this diagram, we see the incisor (*a*) lying in the lower jaw. We also see the epithelial lining of the floor of the mouth (*c*) and the epithelium of the outer surface of the lip (*d*). On the labial surface of the tooth, we find the enamel epithelium.

Figure 2 corresponds to section 1 of the diagram. This section, from a rat 1 day old, was taken in front of the tooth through the soft tissues. We see the mouth epithelium (*a*) in continuation with the epithelium of the lip (*b*). Near the outer epithelium, we observe hair follicles (*c*). In continuation with the mouth epithelium and forming a loop in the soft tissues of the jaw, we see the epithelium of the lip furrow band (*d*). The two epithelial projections (*e*) from

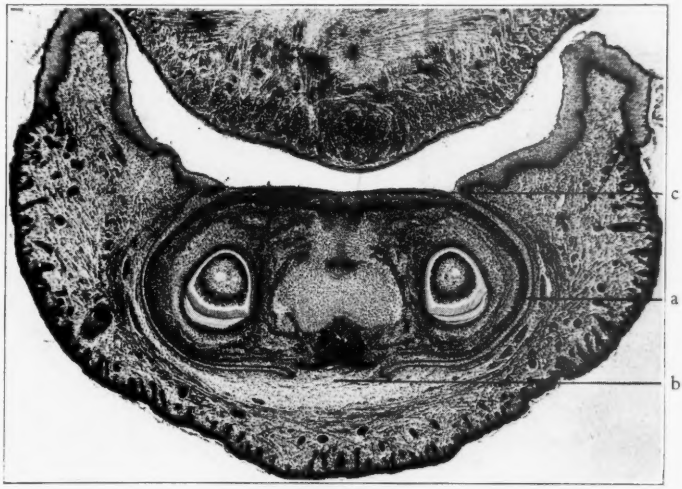


Fig. 6.—Section still further distally, from rat (Figs. 4-5). *a*, lip furrow band; *b*, separation through the raphe; *c*, future lip furrow.

This we can follow to the tip of the tooth, to Hertwig's epithelial sheath. Between the enamel epithelium and the epithelium of the outer surface of the lip, we find an epithelial band called the lip furrow band (*b*). The peripheral end of the tooth is covered with epithelium which is in connection with the mouth epithelium. This epithelium on the lingual surface of the tooth constitutes the dental lamina.

the mouth epithelium into the loop are the incisal ends of the dental laminae.

Figure 3 corresponds to section 2 of the diagram. This was also obtained from a rat 1 day old. In this section, we observe, in addition to all of the structures described before, the incisors (*a*) connected with the mouth epithelium (*b*) by means of a thin lamina (*c*).

Figure 4, from a rat 4 days old, corresponds to section 3 of the diagram. The

dental lamina has disappeared and only a few epithelial buds remain to indicate its former presence. The dentin is developing, and on the labial surfaces of the teeth (*a*), enamel is being formed. The lip furrow band (*b*) completely encircles the jaw.

sides than in the center. The development of cartilege and bone has begun.

Figure 6 corresponds to section 5 of the diagram. This section was taken from a rat 4 days old. The ends of the lip furrow band (*a*) are more widely separated (*b*). On the lingual surface of

Fig. 7.—Labiolingual section through one side of the jaw of a rat 11 days old. *a*, hornification; *b*, separation; *c*, epithelium of the lip; *d*, epithelium of the gum; *e*, pulp of the tooth.

Figure 5 corresponds to section 4 of the diagram. This section is also taken from a rat 4 days old. A break in the continuity of the lip furrow band (*a*) has occurred. This break is explained with the median raphe. The lip furrow band extends farther distally on the

the mouth epithelium, two little grooves (*c*) indicate the location of the future lip furrow. Still farther back in the mouth, the lip furrow band becomes more and more shallow.

In a later stage of development, a separation between the cells of the lip fur-

row band takes place, and through this process, the lip becomes separated from the gingiva, this separation giving rise to the vestibulum oris. Before this separation takes place, a hornification of

sion of the lip furrow. The hornification (*a*) of the epithelium in the center of the band has proceeded almost to the end of the lip furrow band. The actual separation (*b*) has taken place about one-

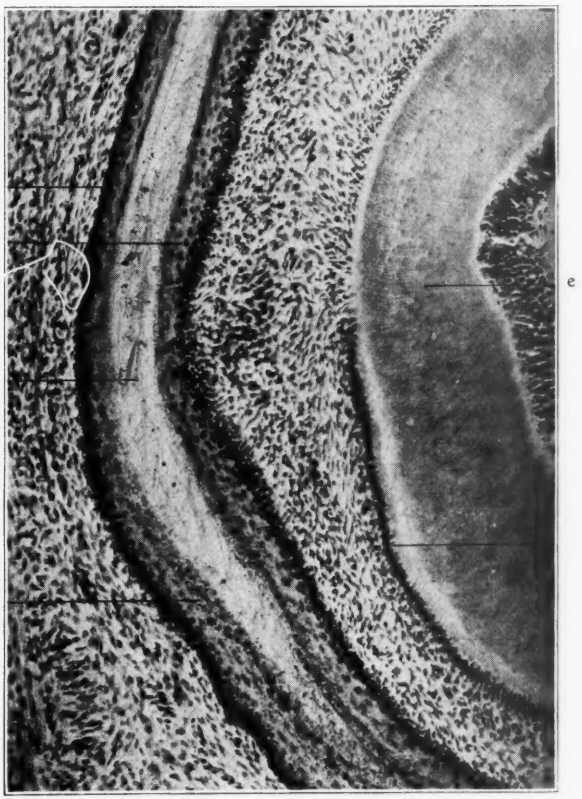


Fig. 8.—A higher magnification of region *a* of Figure 7. *a*, hornified center of the lip furrow band; *b*, epithelium of the later lip; *c*, epithelium of the later gum; *d*, keratohyalin; *e*, dentin; *f*, enamel organ of the incisor.

the epithelial cells through the center of the lip furrow band may be noted. The hornification takes place far in advance of the separation. Figure 7, from a rat 11 days old, shows a stage of this divi-

third of the way. Figure 8 is a higher magnification of region *a* of Figure 7. It shows a hornified center (*a*) of the lip furrow band. Between the hornified center and the outer well-stained epi-

thelial cells (*b* and *c*), we observe layers of cells undergoing various stages of disintegration preceding hornification. A granular layer (*d*) is to be seen. P. G. Unna[1] describes this as a normal stage preceding hornification. It need not is of special interest to us because we find an analogous process preceding tooth eruption and pocket formation.

Figure 9, taken from a rat 8 days of age, shows an upper incisor (*a*) just before eruption. We observe the incisal tip

Fig. 9.—Incisor of a rat 8 days old; before eruption. *a*, tooth; *b*, epithelium; *c*, keratohyalin; *d*, hornification.

absolutely occur, but it is a very characteristic stage. This layer has been called the keratohyalin layer by Waldeyer. This whole biologic phenomenon covered with epithelium (*b*). This epithelium is united with the mouth epithelium (*c*). The outer layer of the mouth epithelium shows a very thick layer of hornified substance (*d*). If we compare the epithelial cells over the tip of the

1. Unna, P. G.: Histochemistry of the Epidermis, Leipsic: Franz Deuticke, 1928.

tooth with the normal well-stained cells of the mucous membrane, we observe a difference in the staining reaction of the cells overlying the tip. The cell outlines and nuclei are less distinct. This is certainly a stage previous to hornification, only hornification (*a*). We can easily follow the hornified layers of the mouth epithelium (*b*) into the attached epithelium (*c*) of the tooth. It shows a beginning separation of the cells of the hornified layer. This marks the beginning of

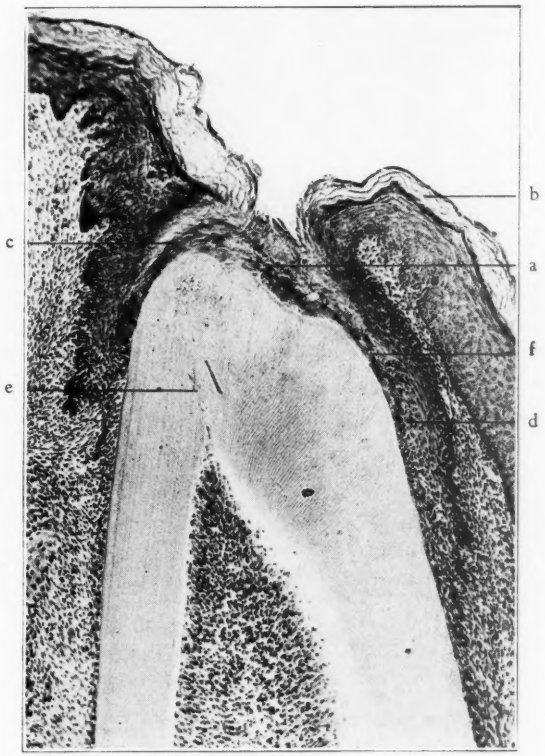


Fig. 10.—Same area as that shown as Figure 9, with hornification more advanced. *a*, hornification; *b*, hornified mouth epithelium; *c*, hornification of the crevice epithelium; *d*, epithelial attachment; *e*, tooth; *f*, keratohyalin.

most likely following the keratohyalin stage. A little laterally, keratohyalin (*c*) may be observed. Figure 10 shows a somewhat further developed stage. The epithelium covering the tip of the tooth has lost its staining reaction and shows the development of the crevice. Part of the cells of the hornified layer remain attached to the tooth, the other portion to the detached portion of the crevice epithelium. These findings strongly substantiate the early findings and descrip-

tions of Gottlieb,[2] who described a similar condition in human material and called the hornification of the stratified squamous epithelium a preparation of the tissues for separation before eruption of the tooth. Gottlieb considers as ideal the condition in which a well hornified layer of cells is found on the surface of the tooth (cuticula dentis) as a protective against caries and a well hornified crevice epithelium as a protective against infections of the pericemental membrane.

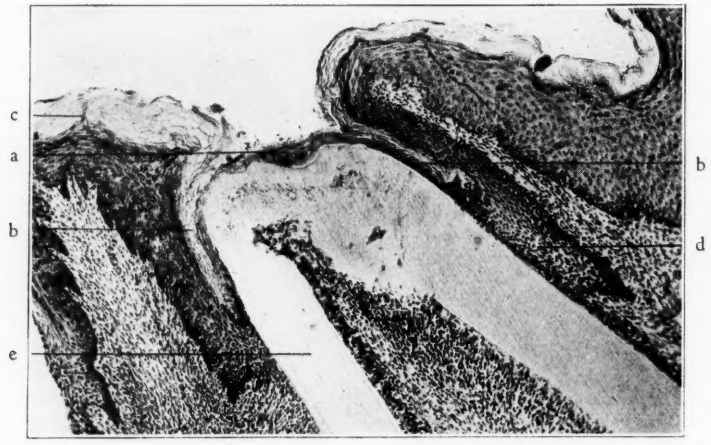


Fig. 11.—Incisor just erupting. *a*, hornified layer on the surface of the tooth; *b*, hornified crevice epithelium; *c*, hornified mouth epithelium; *d*, epithelial attachment; *e*, tooth.

In our specimens, we find such ideal conditions on the erupting teeth of the rat.

Figure 11 shows a more advanced stage. We see both hornified layers, one covering the surface of the tooth (*a*), the other covering the crevice epithelium (*b*). The hornified layer of the crevice epithelium is in direct continuation with the hornified layer of the mouth epithelium (*c*). Figure 12, a higher magnification of Figure 11, shows the same area in greater detail. The hornification of the mouth epithelium (*a*) can be followed into the crevice epithelium (*b*). It has proceeded deep into the tissues, extending far in advance of the actual separation. At the deepest point of hornification, if we observe very closely, we see keratohyalin (*d*), evidence that further hornification in the epithelial attachment (*e*) is to follow. There can be little doubt that the hornification deep into the tissues marks the course of the developing crevice. On the surface of the tooth, a hornified layer remains after separation. In later stages, we cannot always find this hornified layer on the surface of the tooth.

These very vivid examples of hornification preceding crevice formation recall some of the discussions of the past on hornification and the causes which lead to this hornification.

2. Gottlieb, Bernhard: Etiology and Prophylaxis of Caries, Ztschr. f. Stomatol., 3: 1, 1921.

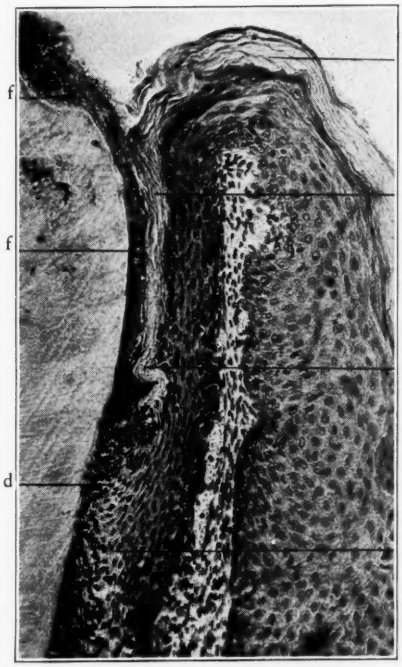


Fig. 12.—Higher magnification of the gum margin of Figure 11. *a,* hornified mouth epithelium; *b,* hornification preceding crevice formation; *c,* deepest point of hornification; *d,* keratohyalin; *e,* epithelial attachment; *f,* hornified layer on the tooth surface.

In 1922, Weski[3] stated that he had been unable to observe any hornification over the tips of teeth just before eruption. He observed only thinning of the overlying epithelium. Neither has he been able to observe any hornification along the tooth surfaces preceding eruption. Euler,[4] in discussing the work of Weski and Gottlieb, carefully stated that only rarely could one obtain an impression of a hornification of the outer enamel epithelium such as Gottlieb would have as the rule. Further, a hornification such as is found on the mouth epithelium he could verify in neither human nor animal material.

With reference to the causes that bring about hornification, Haupl and Lang[5] strongly stress inflammation, but mention also the influence of function. They believe that, under pathologic conditions, the epithelial cells are transformed into a homogeneous membrane. While Euler[4] entertains similar views, he again carefully states that he could not convince himself that a hornification takes place, but that a membrane is formed and that inflammatory processes must be placed in the background; and that only mild inflammatory processes accompany the development of this membrane.

In this series, hornification such as we have illustrated could be observed in every instance of erupting teeth. We believe this to be a characteristic state for rats' teeth. With reference to the cause that leads to this hornification, we can concede only function. Under function, we understand not only the forces applied during feeding, but also the forces exercised during eruption of the teeth. We do not desire to stress this fact, because the animals were very young and the hornifications rather extensive. We can, upon the basis of our material, in no way connect this hornification with inflammatory processes of any nature.

3. Weski, O.: Roentgenologic-Anatomic Studies of the Domain of Jaw Pathology, Vierteljahrschr. f. Zahnheilk., 1:3, 1922.

4. Euler, H.: Epithelium in Recent Literature, Vierteljahrschr. f. Zahnheilk., Vol. 1, 1923.

5. Haupl, C., and Lang, F. J.: Marginal Parodontitis, Berlin: H. Meusser, 1927.

INDIVIDUAL MOUTH RECORDS*

By ELMER W. BUNCE, D.D.S., Los Angeles, Calif.

IN presenting this paper, I have in mind, particularly, the problems of the general practitioner. Most of our denture specialists and many others have sufficiently solved the problems of denture construction that with their own technic in their own hands, they are able to get very satisfactory results. However, the fact remains that by far the greater number of dentures are made by men in general practice who have only a superficial knowledge of the work. It is a worthy ambition to help these men to build better dentures. It is a well-known fact that more than 75 per cent of the profession turn their denture cases over to a commercial laboratory after taking impressions and bite, with practically no individual records for the technician to follow.

Such a procedure, of course, results in many failures and much grief to all concerned. This condition assures us that two things at least are essential: The dentist must have a fair knowledge of the principles involved in modern denture construction and carry his cases through himself, according to some definite technic; or he must supply a trained technician with accurate records, thus enabling him to carry out the individual requirements of the case. It has been proved that this can be done, but we have found that the general practitioner cannot or will not give sufficient time and study to master the intricate details of a complicated technic. He must have a simple yet accurate method of procedure, requiring a minimum amount of his time.

The subject of full denture construction involves the replacement of lost teeth with mechanical substitutes, whereby we attempt not only to restore to the patient his ability to masticate his food efficiently but also, and, at the same time, to maintain or improve facial contour and personal appearance. Most patients gladly lend all the assistance they can, because of a sense of pride and because of their desire to maintain good health. By far the greater part of the responsibility for the success of any case, however, rests upon the dentist.

A few years ago, it was thought that the most important step in full denture construction was to obtain perfect impressions. You are all familiar with the great progress made in impression taking. However, we have discovered that we must do more than secure good impressions. Our dentures must observe certain mechanical laws and they must be made to function in harmony with whatever remains of nature's mechanism. The fixed parts of the human masticating machine, i.e., the maxilla and the condylar fossae, do not concern us greatly except as they become changed through use or misuse, but the movable parts present a

*Read before the Section on Full Denture Prosthesis at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 22, 1928.

very different problem. The movements of the mandible in its variations and complexities are difficult to investigate. The study of denuded skulls reveals only anatomic details. Even wet specimens are insufficient because, in them, the element of muscular action is lacking. We are therefore forced to study and measure mandibular movements in the living subject, and various methods of observing and recording these movements have been suggested. But regardless of what method is used for securing these records, they are eventually transferred to some form of adjustable instrument which, when properly adjusted, will imitate more or less accurately the individual movements of the mandible.

No two individuals have exactly the same mannerisms, the same facial contour or the same mandibular movements. They may be similar and follow the same general plan, but they are not exactly alike. This similarity of mandibular movement might be called, for convenience, normal movement, and as we find the greatest similarity among our patients who still possess a full complement of teeth in perfect occlusion, we have come to accept such cases as representing what we call normal. Abnormal movements occur or develop from any one or more of several conditions, such as loss of teeth, abrasion or malocclusion from any source, including injury and disease. Whatever the cause, it naturally follows that the individual is forced to make unnatural movements of the mandible in his attempt to masticate food. Even edentulous patients try to masticate; and if these unnatural movements are persisted in for some time, they become habitual, the muscles of mastication and the temporomandibular articulation adjusting themselves to the condition, and when we come to build dentures for such a case, we, of course, have these so-called deformities to deal with.

Let us not overlook the fact that the muscles of mastication are the dominating influence which actually brings about these changes. In fact, throughout life, they exert this influence. Is it not a fact that, from the time in the eruptive period when the teeth of the opposing jaws began to resist the forces of occlusion, the teeth so arranged themselves that their long axes were parallel, or nearly so, to the lines of force represented by coordinated muscle pull? Also, you will recall that the mandible of old age sometimes straightens out until it often resembles the infant mandible; another instance of the influence of muscular contraction. In all abnormal cases, then, we would expect to find a certain amount of both muscular and condylar deformity, if we may call it such for want of a better term, and the one compensates for the other, else we would not have harmony of function. Muscular "deformity" is simply overdevelopment in some, and atrophy in others, according to the demands placed on them, and may be corrected.

One thing is certain: Every patient who comes to us for dentures has certain habitual movements of the mandible, whether normal or abnormal, and the degree of immediate satisfaction and comfort which he experiences with any dentures that we build for him will be in direct ratio to our success in giving him dentures that fit and function in harmony with his habitual movements. Of course, to attempt to correct the position of the mandible and restore normal mandibular movements is another story; and this brings us to a consideration of the two methods of procedure open to us in every case.

All full denture cases may properly be divided into two general classifications, according to diagnosis, and these may even be said to represent two schools of opinion existent in our profession today. One classification we might call conformative denture construction, wherein we build our dentures to fit and function in harmony with existing conditions. The other classification is corrective denture construction, wherein we attempt to correct any abnormal conditions that may exist. This correction may be complete or partial, according to our diagnosis.

Conformative procedure places function first and attempts no readjustment of the anatomic structure, thereby sacrificing, to some extent, improvement in facial contour. It is indicated for the older, less adaptable class of patients, or for any whose greatest desire is for functional efficiency and comfort. Prognosis is always favorable if accurate records are made and followed.

Corrective methods are employed for a patient whose tissues are still flexible enough to permit corrective treatment and whose desire for function and for esthetics is about equal. Such procedure usually requires opening of the bite, changing the position of the mandible in relation to the maxilla, and more or less readjustment of the muscles of mastication and the parts that make up the condylar area. Such dentures may not be comfortable to the patient at first, and he must exhibit sufficient endurance and persistence to wear them until his anatomic structures have adapted themselves to the guiding influence necessitated by the new dentures. If a great amount of correction is found necessary, it is sometimes advisable to correct by successive stages, building a series of dentures, each approaching more nearly the full correction desired. Prognosis is favorable in proportion to the age of the patient; the extent and duration of the deformity; the degree of cooperation the patient contributes, and the skill and good judgment of the dentist. It frequently happens that a considerable improvement in facial dimensions and personal appearance of a patient can be effected by an intelligent combination of conformative and corrective treatment, thereby making a partial correction of the existent abnormalities without seriously affecting the patient's comfort and efficiency.

In any event, our decision as to how we shall treat a given case will be largely determined by our diagnosis of existent conditions. If we are fortunate enough to get the case while some of the natural teeth remain in the mouth we shall learn much from a study of the case before extraction, but as most of our full denture patients come to us edentulous, many of them wearing ill-fitting dentures, we must learn to depend largely on our records for our diagnosis. Before we can decide whether or not it is best to attempt a complete restoration of normal conditions in a given case, we must know what conditions we have to start with and how much change must be made in order to bring that case back to normal, and this must be determined through observation, case history and mouth records. Many methods of obtaining these records have been suggested, but it is my observation that most of them are too complicated for the general practitioner to use in routine practice, or prove to be inaccurate in the hands of many dentists.

Another error in securing mouth records has been the attempt to determine a definite line movement of the mandible. I shall attempt to show that the

tendency of the mandible in lateral excursions is not to travel in the same path with each masticating stroke, although it may be compelled to do so by the guiding influence of opposing cusps. Study of the occlusal surfaces of teeth reveals the fact that in nearly all cases of extreme abrasion the cusps have been entirely obliterated. This proves to us that when we attempt to establish any definite line movement of the mandible, we oppose the natural tendency of mandibular movement and thereby induce trauma. We are all familiar with the effects of locked occlusion in the centric relation, and it is my contention that we produce more or less the same effect when we compel the mandible to follow certain definite lines of movement in lateral masticating strokes. Therefore, it seems to me that it is unnecessary to lay so much stress on definite lateral movements. The important records to obtain are functional centric occlusion and directional movement of the mandible in protrusion. By functional centric occlusion, I mean the centric occlusion position which the patient has when he comes to us for dentures, which is "that position of the mandible where the muscles of mastication in coordinated contraction can register their maximum crushing force." This may not be the position that the mandible occupies when the muscles are relaxed or when the condyle heads are resting lightly in their fossae, but it is the position that is habitual to the patient in mastication, and we must know what it is, whether we elect to build our dentures to conform to it, or attempt to restore it to its previous normal position.

We determine and prove functional centric occlusion by the use of the temporal muscle test, as you will see later. The other important record to obtain is the directional movement of the mandible, and this also must be the natural, habitual excursion of the mandible from the time it leaves centric occlusion position until it arrives at the protrusive position. Two things are important in securing this record, if it is to be accurate. First of all, the protrusive record must include an opening component equivalent to the cusp height, and, secondly, the free, gliding movement of the condyle heads in their fossae must not be interfered with, or influenced by the use of any recording material or appliance that offers resistance to that free unguided movement.

This record is so easily obtained that any operator can get it with great accuracy with the method which I shall show you. You will notice that we take our protrusive bite record in plaster, carried to place and loosely confined in a dental napkin. The plaster must be very soft and nonresistant, the baseplates must be firmly adherent to the mucosa, and the patient must be instructed to protrude and close gently into the soft plaster, making no effort to bring the bite rims together, but closing just far enough into it to register the protrusive position in combination with the opening component. With this plaster record, it is an easy matter to adjust the condylar guidance of any adjustable articulator so that it will reproduce the directional movement of the mandible. In taking this record, if one condyle head moves forward a little farther than the other, thus effecting a slightly lateral deviation, it does not matter, as what we are after is directional movement in protrusion and we will get it if both condyles move a sufficient distance from the centric position.

When we have secured the records that I have just mentioned, we have all

that is necessary for the successful construction of full dentures except a record of the lateral variation in the shift of the mandible, which also includes an opening component. We may determine this by the use of lateral checkbites, but I do not use them for the reason that a lateral checkbite registers only one lateral movement, and the tendency of the mandible, as stated before, is not to travel in one definite path in its lateral excursions. Therefore, when I compel it to follow just one line of lateral movement, I am inhibiting that natural tendency, with the result that we have a shifting of the denture bases on the supporting tissues, inducing trauma and atrophy. The better way is to accommodate as many of these lateral movements as we can and still retain efficient masticating surfaces, and this is done by the employment of a milling technic which provides a certain amount of freedom of lateral movement and yet preserves enough cusp form for the efficient shearing and the crushing of food. This also is a simple procedure, and one which not only accommodates a wide range of movement in mastication, but most efficiently destroys locked occlusion and has a stabilizing effect on the dentures.

In the foregoing discussion, I have presupposed the use of the conventional type of posterior teeth. Recently, posterior teeth of a new type, designed by Victor H. Sears, of New York, have come to my attention, and, while I have not had an opportunity to try them on practical cases, I can see at a glance that Dr. Sears had in mind the idea of absolutely removing any possibility of getting locked occlusion with them; and, moreover, he has eliminated high cusps and deep sulci and made provision for a wide range of lateral movement.

SUMMARY AND CONCLUSIONS

Granting that no two individuals have exactly the same anatomic structure or the same mandibular movements, we must assume that each case presents its own individual peculiarities, developed through habit or misfortune, or both.

We may diagnose each and every case by first establishing functional centric occlusion and then securing accurate records of the directional movements of the mandible. Having done so, we may build dentures that function in conformity with existing conditions; we may correct them, restoring what we consider normal conditions; or we may make a partial correction.

In any event, our decision will probably be influenced by the patient's age, mental attitude, habits, environment and functional and esthetic desires.

Elimination of locked occlusion is absolutely essential in all cases.

Modern denture construction demands some form of adjustable articulator, whether we elect to follow conformative or corrective procedure. The more we oppose the natural tendency of the mandible in its lateral excursions, the more punishment we inflict on the supporting tissues.

Successful full dentures can be constructed by our vast army of general practitioners, but they cannot build them all to one standard or average formula and expect success. They must take individual mouth records, and they will attain the greatest percentage of success by building dentures that conform to the habitual requirements of the patient, rather than attempting extensive corrections. Full denture technics have been, for the most part, too exacting, this limiting their use to a few highly trained prosthetic experts. The need of the hour is for a simple technic

that will enable all of us to make practical use of accurate individual mouth records, and the fewer records necessary, the better. I have little difficulty in getting almost any dentist to register functional centric occlusion and to take accurate protrusive bite records in plaster, but nearly all of them seem confused, and shrink from the use of lateral checkbites. I have tried to show that, in full denture work, the lateral checkbite is the one most apt to get us into trouble, and it can be eliminated, provided we so mill, or grind, the occlusal surfaces of the teeth that we allow as wide a range of lateral movement as is consistent with efficient mastication.

I have no intention to discourage those who are capable, and wish to pursue corrective methods in every case, but I do suggest that they first determine existent conditions and then temper their corrections with John P. Buckley's "tincture of good judgment and fluid extract of common sense."

DISCUSSION

James J. Guerrero, Chicago, Ill.: The object of Dr. Bunce's paper is to simplify scientific denture construction. I shall outline a simplified, scientific technic that has been used by the busy general practitioner. I believe that it is good business, also good professionalism, for this individual to avail himself of the services of a well-trained technician to whom he may relay most of the work that is to be done out of the mouth. It should be understood that the technician is a part of the office personnel. In the making of full upper and lower dentures, he should contribute at least three-fourths of the time necessary. With the foregoing definitely understood, I shall outline a simple, scientific and accurate technic for the construction of full upper and lower dentures that ordinarily consumes from four to seven hours of the operator's time in 95 per cent of cases. At the first sitting, we should get the case history and take preliminary impressions. At this time, we should also quote our fee and make arrangements as to how it should be paid. The snap impressions are given to the technician for the making of individual tray preparations and an upper wax baseplate, the latter being used as a medium to mount the upper six anterior teeth while the operator is deciding on the proper form and size. At the second sitting, we should take maxillary and mandibular impressions. I favor taking impressions by a method whereby the minimum cooperation is necessary on the part of the patient. Using the tooth selection base, we should select teeth of proper size, form and color. The impressions and the tooth selection records are given to the technician for the construction of permanent bases. The technician develops mounting casts and contour rims of somewhat greater height than is required. He should set the six maxillary anterior teeth is such a position as in his judgment would be normal for the case. At the third sitting, the face-bow, centric and protrusive records are taken. At this time, it is advisable to adjust and check the setting of the six maxillary anteriors. We must use an articulator capable of reproducing movements equivalent to those we have recorded in the mouth. The maxillary base should be mounted in the same relation to the frame hinges that the maxillary ridge bears to the center of the glenoid cavity. The accepted centric relation record should be the most retruded unstrained position of the mandible in relation to the maxilla. The protrusive bite record should be a forward excursion of about 6 mm. The mounting of the casts and the setting up of the teeth should be performed by the technician. The wax model dentures are finished and tried in. The registrations are rechecked and the necessary alterations made, and the case is turned over to the technician for vulcanizing and finishing. The finished dentures are placed in the mouth, a new centric record is taken and the teeth are ground in by the technician to balanced occlusion. The average operator can follow out the foregoing technic, giving scientific denture service and spending from four to seven hours with each edentulous patient.

C. J. Stansbery, Seattle, Wash.: Dr. Bunce expresses what I consider a very laudable ambition: to help the general practice man to build a better denture. I think that he has been very conservative in his estimate that 75 per cent of dentures are made in

commercial laboratories from impressions and bites with no individual records whatever. He says that the general practitioners cannot or will not give sufficient time and study to master the intricate details of a complicated technic. Here, I believe that he has set up a man of straw; for, at the present time, there is a technic not complicated and presenting no details that are intricate, but representing the results of much technical research that is both intricate and complicated. For an apt illustration that I have used before: The electrical engineer, in a treatise on spark plugs, could fill pages with technical description and scientific research on induction coils, high potential voltages, spark gaps, etc., but you can teach a 10-year-old to take advantage of all this with a pair of pliers and a thin dime. Dr. Bunce was talking directly at me when he said that, a few years ago, it was thought that impression taking was the most important step in denture making. When I gave the profession my negative pressure technic of impression taking, I thought just about that. Now I think that it is a long, long way from the most important. The most important is that, as Dr. Bunce says, our dentures must be made to function in harmony with whatever remains of nature's mechanism. Allow me here to bring up a point that is food for thought. We do not record movements; in fact, if the patients moved, it would spoil our record; we record positions and adjust our instrument to move arbitrarily from one recorded position to another. At first thought, you may consider this to be hair-splitting distinction, but, as I said, it is food for thought, and the longer you think, the wider the hair will become. Your absorption of this fact will greatly assist you to understand all types of adjustable instruments. I most emphatically do not agree that one position and one directional movement constitute sufficient data for any one to build dentures in 1928. My criticism of the paper is that the ideal recommended is not sufficiently high. Better have a high standard and fail after an honest attempt to reach it than a half way mark easily attained.

Dr. Bunce (closing): We have met cases in which the patient closed, in functional centric occlusion, as much as half an inch forward of the retruded position, which I call the rest position. The apparently protruded position would be the functional centric occlusion. I do not take a chance as to that. I allow the patient to rest where he pleases as long as he is able to masticate. As regards the protrusive bite, we do not always get just what we want, but what we do want is for the mandible to move a sufficient distance forward so that we will be able to adjust the condylar guidance on the articulator. The only difficulty that we have is to get the patient to protrude the jaw enough, and that can usually be left to the patient. Before we take this record, the patient is always instructed and rehearsed in this movement. Dr. Stansbery challenges the advisability of having denture work done by technicians who are not competent. Several years ago, I had the privilege of being an assistant to a man who was giving postgraduate courses in denture work, and in going back over that territory, I found few men using it, because it was too complicated and to do all the work required too much of the dentist's time. Also, the technicians were not trained to do any of it. Dr. Stansbery is right in saying that checkbites do not record movements. We do not record movements, we record positions; and if we can record these positions, the line of movement will be shown by the records. If the patient moved, it would spoil the records. In regard to the teeth, we must use whatever kind of surfaces will most efficiently masticate food with a minimum amount of applied force, and, for that reason, many men now recommend the use of teeth designed to cut through the food with the least pressure. We must reduce the matter of trauma of the supporting tissues by reducing the amount of muscle force required to cut through the food.

THE USE OF SOME OF THE NEWER ANTISEPTICS IN DIFFUSE ORAL INFECTIONS: INDICATIONS AND CONTRAINDICATIONS*

By S. L. SILVERMAN, D.D.S., F.A.C.D., Atlanta, Ga.

THE success that has met the quest for nonpoisonous and nonirritating antiseptics has, in many instances, acted injuriously to results in oral surgery.

Such agents as mercurochrome, hexylresorcinal S.T. 37, metaphen, gentian violet and other of the newer antiseptics, though admirable agents in simple acute conditions, are not at all efficacious in extensive oral lesions involving the bony structure. I am aware that, in making this statement, I am inviting criticism, and I shall, therefore, attempt to state clearly my contentions and reasons for the deductions herein set forth.

Let this not be construed as meaning that the newer antiseptics or germicides are put under a ban. On the contrary, I am of the opinion that they are decidedly the best agents to use in skin and mucous membrane affections. They are certainly the peer of the irritating agents, such as iodin, for sterilizing the skin and mucous membranes. They are also indicated in surface or near surface abrasions and affections. On the other hand, they are quite inferior in chronic diffuse infections as compared to iodin. Let it be remembered that the nonirritating property of the newer antiseptics is no longer a virtue when it comes to dealing with affected bone. To the contrary, what is wanted and needed is an agent that is irritating, and one that, in addition to destroying germs, will have a stimulating effect on the tissues. I know of no better antiseptic than iodin that has this necessary counter-irritating property.

In naming the various newer antiseptics, I did not include surgical solution of chlorinated soda (Dakin's), because this solution differs from such agents as mercurochrome, hexylresorcinal S.T. 37, and metaphen in that it is decidedly irritating and owes considerable of its success during the late war to that one virtue.

I did not reach the conclusions herein voiced through prejudice to these agents merely because they are new, but because I had observed failures in my own practice in cases in which I had been accustomed to better results. I accordingly returned to iodin, and immediately my successes returned to their former percentage. I have, of course, also had the opportunity of observing the progress of the cases of other operators, and I was soon convinced that, in spite of the claims for these agents, they were lacking in something that iodin possessed. That something I found to be the counterirritating property. All the statements here made refer to oral sur-

*Read before the Section on Oral Surgery, Exodontia and Anesthesia at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 23, 1928.

gical cases, as all the observations and studies were made in this branch of surgery.

One other virtue that iodin has in the oral cavity is its control of moderate pain in inflamed tender gums. This, in turn, is due to its counterirritating property. A simple and convincing experiment can be made in order to verify my claims. Let one select a case with an incipient periodontal abscess and apply any of the newer antiseptics above mentioned. Will the inflammation be drawn nearer the surface? Will the pain be minimized? I am sure no improvement will be noted. In a similar case, or in the same case, the next day dry off the affected part and apply tincture of iodin. Every one of experience knows what will follow. A much more convincing experiment can be made in mouths having a general painful periodontoclasia characterized by bleeding and flabbiness of the gums. On one side, apply the nonirritating antiseptic and, on the other side of the mouth, apply the iodin. The improvement objectively and subjectively will be noted to favor the side to which the iodin was applied.

In osteomyelitis, periostitis and diffuse infections of the floor of the mouth, including Ludwig's angina, surgery is first indicated. All incisions for drainage of pus should be liberal and at the most pendent portion of the infected area. Extra-oral incisions should be resorted to if drainage can be better accomplished. If irrigation is to be employed, surgical solution of chlorinated soda is by far the best agent. Should the condition become chronic, with more or less exposed bone, iodin in various strengths is the agent of choice, while the newer antiseptics are totally impotent.

CONCLUSIONS

My championing of iodin to the exclusion of other antiseptics in chronic diffuse affections, especially those with more or less exposed bone, should not be construed as due to an unwillingness to follow the modern trend. I have already stated that mercurochrome, hexylresorcinal S.T. 37, metaphen and gentian violet have their indications. Thus, we know that, for intravenous antiseptics, any of these far surpass iodin, which, in fact, cannot be used intravenously. Nor must it be concluded that I use iodin exclusively in the oral cavity. In Vincent's infection, we find iodin absolutely worthless. What I do contend is that, in seeking for a nonirritating antiseptic, a great many oral and dental surgeons have lost sight of a very important therapeutic adjunct in dentistry and in medicine, namely, a counterirritant. Having lost sight of this, they at once lost the pain-controlling feature as well as the stimulating effect that iodin possesses and exerts over semi-vital tissues.

Succinctly, one must realize that many wounds, whether or not infected, heal without any antiseptic. But in extensive chronic wounds of indolent tendency, not only are counterirritants of value, but also actual scarifying or cauterization may be needed. The action, then, of such agents as iodin may be classed as analogous to the stimulating effect of scarifying, wherever and whenever they are needed to hasten resolution. Finally, even though we are justified in using the bland and nonirritating newer antiseptics for irrigation in the various diffuse infections of the oral cavity, they should be supplemented with a periodic application of iodin.

DISCUSSION

Aubrey L. Martin, Seattle, Wash.: I am sure this section has been interested in this paper and has enjoyed its brevity, as it is quite a contrast to some of the lengthy presentations we have sat through. We all agree as to the merits of the nonirritating antiseptics for sterilization of skin and mucous membrane. But why do we not get results in the deep diffused chronic infections? Because we cannot sterilize these tissues. The only treatment I know of in these infections is heat and drainage. When we use a solution for irrigation, we use it as an irritant to stimulate growth of tissues and not as an antiseptic. We cannot get asepsis in osteomyelitis, periostitis, cellulitis or any of these diffusing tissue infections by the use of an antiseptic, but we can assist drainage by washing out débris, and promote tissue growth by the use of an irritant. We sometimes inhibit the resolution of the infection by too much irrigation. The surgeon often opens a carbuncle or removes a ruptured appendix and establishes drainage, but does not irrigate. The orthopedic surgeon removes areas of necrosis and sequestrums of bone, packs cavities with vaselin or gauze impregnated with vaselin, but does not irrigate; nor is any antiseptic used. Iodoform gauze has been discontinued for drainage as the iodoform cannot establish asepsis. Sterile gauze and vaselin have been substituted. Some of us use chromic acid in periodontoclasia. This is not used as an antiseptic to sterilize the pocket but as an irritant to stimulate growth. In our dry sockets, which are nothing more or less than an osteitis, our application of silver nitrate or phenol does not render the socket aseptic but anesthetizes and stimulates new growth. I agree with Dr. Silverman that surgical solution of chlorinated soda and iodin are among the best irritants in chronic infections. I am also glad that he made the point that it is not indicated in Vincent's infection as it is not an uncommon thing to receive referred cases in which the dentist has been swabbing with iodin. The only point I have tried to give you in this discussion is that these irritating solutions used in irrigation are not used for their antiseptic properties but for their stimulating properties.

Theodor Blum, New York City: I shall relate my experience with a case of osteomyelitis of the mandible, treated probably about ten years or so ago, when we still used irrigation. The infection had spread from one side to the other so that, at that time, the whole mandible had been affected. We used surgical solution of chlorinated soda on one side for irrigation and physiologic sodium chlorid solution on the opposite side, and, to my great astonishment, on the side treated with the former, healing was very much delayed, owing, I believe, to the fact that the normal repair processes and the processes of building up resistance had been destroyed by the solution, which from that time on, I discontinued using altogether. In my own practice, I only use iodin, argyrol, 25 per cent, and zinc chlorid, 8 per cent; iodin only for denoting and sterilizing the point of insertion of my needle for injection. I practically never use iodin for anything else. The 25 per cent argyrol I use as a general cleaning solution, swabbing the mouth before and after operation with it. Zinc chlorid, 8 per cent, is used for any of the infections in the mouth, especially for canker sores. I do not think that, at the present time, there is still a need for using irrigation in cases of osteomyelitis. Local application of heat or cold, and the frequent use of a mouth wash, physiologic sodium chlorid or boric acid solution, will do all the cleansing that is necessary. The main thing in treating all infections of the mouth or any other part is not the application of an irritant, counterirritant, or antiseptic. The main thing is to build up the resistance of the patient, and this is done by proper feeding and proper elimination. I am always reminded of a statement which a very old physician, Paracelsus, made in the fifteenth century, to the effect that all we have to do is to help Nature along and everything will be well, but if we oppose Nature, we are inviting trouble.

Harry M. McFarland, Kansas City, Mo.: As to the indications for or contraindications to the use of some of the newer antiseptics, I should like to ask Dr. Silverman the advisability or inadvisability of using an antiseptic such as 1/500 solution of rivanol, or the antiseptic that he thinks would be favorable in such cases after operating. We know that some of these cystic areas are sterile, and some of them are not. In removing some teeth, we also have pus sacs to remove. Undoubtedly, those areas

are infected. Is it better to use some antiseptic after the surgical removal or cleaning up of these areas, or is it better to close the area immediately without the use of any drug?

Dr. Silverman (closing): Dr. Blum mentions a single case of osteomyelitis that had been treated on one side with surgical solution of chlorinated soda and on the other side with physiologic sodium chlorid solution, and states that the side that was treated with the former showed effects of having been unduly irritated or poisoned in some way. That may have been due to the solution. I rarely use it. I rarely use irrigations of any kind. I prefer liberal incisions, and I establish drainage. A single case cannot be taken as a criterion. I have seen cases not treated with anything, and one side was worse than the other. One side would get well of its own accord, and the other side would not, requiring an operation. The building up of a patient with Ludwig's angina is almost impossible. In nearly every case that I have in mind at present, it was even difficult to feed the patient at all. I have had cases in which they could not even take water by mouth. I have had cases in which there were openings underneath the body of the mandible and through the mouth, and water would run from the mouth down on the chest. It would be impossible to feed patients who were in such a serious condition. Rectal feedings, consisting mostly of physiologic sodium chlorid solution, fortunately, afford nutrition, if retained.

Dr. McFarland's question as to the use of antiseptics after minor oral surgical operations, particularly those following extractions, I think Dr. Blum has answered, in quoting Paracelsus. I always believe in giving those small areas nature's treatment. In our college work and in private work, we do not use any sort of antiseptic in these minor operations, and the patients get along well. Infections follow, at times, but infections also follow operations when a surface application has been made.

THE ROENTGEN RAY AS AN AID IN EXAMINATIONS*

By E. C. HUME, D.D.S., F.A.C.D., Louisville, Ky.

THE standard of service required of professional men becomes higher each day, and it behooves each of us to avail ourselves of all possible means and methods to the end that we may arrive at a correct diagnosis in each case, without which all treatment is guesswork or empiric.

The roentgen ray will never be more than an aid to our profession, for it cannot, and was never intended to, take the place of those clinical signs and symptoms which we must be able to interpret correctly if we are to give the best service to those whose health is entrusted to us.

A carefully made set of roentgenograms will often add to our clinical findings, but, let me repeat, it was never intended to take the place of our special senses which the good Lord gave us. However, some of the important factors in our examinations are easily ascertained by means of the roentgen ray and I feel that every dentist should have access to a roentgen-ray machine and have a fair knowledge of the subject. If for any reason this is not possible or practical, we should avail ourselves of the advice and consultation of one who can supply both the knowledge and the

*Read before the Section on Operative Dentistry, Materia Medica and Therapeutics at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 22, 1928.

equipment. I have no respect for the shooting gallery type of roentgen-ray laboratory, where money is the first consideration and where pictures are turned out at $5 per set of ten as a complete roentgenographic examination. Most people who visit such places get cheated. Fourteen films should be the smallest number supplied, and, in many cases, eighteen or twenty films are necessary to complete an examination of the mouth.

There are many instances in the daily routine when the general practitioner needs the aid of a correctly made, properly interpreted roentgenogram. The ideal dental roentgen-ray picture shows not only the tooth or teeth in question free from distortion, but also a portion of the bone or the teeth anteriorly, posteriorly and beyond the root ends. A picture of the corresponding area on the opposite side of the mouth is of value in many instances. The man who builds wisely knows upon what his structure rests. If the foundation is poor, the superstructure will surely fall.

As dentists, we should investigate the foundation upon which we build just as carefully as the engineer who builds the skyscraper investigates the foundation upon which he builds. In many instances, the foundation of our work is the osseous structure that has supported or now supports the teeth. The roentgen ray enables us to investigate this foundation easily.

One of the most embarrassing things that occur in our practice is to have a patient return shortly after a beautiful restoration has been made and placed in the mouth, with pain, or perhaps with a set of roentgenograms, showing unerupted teeth under a partial or full denture, a fragment of root under a bridge, a pulp stone or a cavity in a tooth used as an abutment piece or for clasping.

If a patient comes in for a bridge and, after careful examination, we feel that the bridge is needed, it is our duty to see that the teeth which are to support the bridge and that portion of ridge between these teeth are free from disease and abnormalities which would impair the usefulness of the structure or injure the health of our patient. The same principle applies in partial or full dentures. The ridge must be free from disease, unerupted teeth or root fragment if the construction is to give the service for which it was built. It is impossible to get this service, regardless of how accurately the bridge is made, if it rests on tissue in which there are pieces of alloy, bits of enamel, inlays, roots of teeth or cysts. In some cases, I have found portions of broken instruments. In many instances, after the removal of the offending substance, it was necessary to reconstruct the appliance. The finding of such conditions is not uncommon in a large roentgen-ray practice.

In making examinations and restorations of the exposed surfaces of the teeth, carefully made bite wing films will often disclose beginning caries on the proximal surfaces of bicuspids and molars that otherwise might be overlooked. This same type of film is very useful in checking the cervical margins of fillings and inlays. Thousands of teeth are lost each year because we fail to detect overhanging filling material at the cervical margin. The loss of teeth so filled is serious, to say nothing of the health of the individual, which is constantly endangered by the presence of infection in the supporting structures, which invariably follows the insertion of fillings so neglected. I am

convinced that many cases of pyorrhea are a result of our failure to detect these imperfections in our restorations. Surely no one doubts the value of the postoperative roentgen-ray examination. The postoperative picture, in many instances, is just as valuable as the preoperative one.

Supernumerary teeth, which are not uncommon, are often the cause of malposition of the normal teeth, especially in the anterior portion of the mouth, where the normal teeth continually elongate regardless of the grinding we may do, or will separate regardless of the fact that retaining appliances are left on over the normal period of time. In other cases, the supernumerary tooth or teeth will prevent the eruption of the normal tooth. In a few cases, I have seen normal teeth lost because of excessive force applied by orthodontic appliances when the movement of the tooth was blocked owing to the presence of a supernumerary tooth imbedded in the bone in the path of its intended movement. The presence of most of the supernumerary teeth that I have seen was never recognized until revealed by the roentgenogram, and quite a few of them had cysts around a part or all of the tooth.

There is little excuse for the dentist of today to fail to have all teeth which do not erupt at the normal time examined by the roentgen ray and yet many of our profession fail to investigate such conditions, to their ultimate sorrow and the loss of patients that would have otherwise been retained. Many a good second molar has been lost, not to mention the pain endured or loss in mastication due to an impacted third molar. Many an upper arch has been ruined owing to failure of the cuspids to erupt. Similar conditions are often seen that are due to other teeth failing to erupt and to the presence of supernumerary teeth, all of which could have been prevented if a roentgenray examination had been made and the right treatment instituted at the proper time. Not infrequently, I have had patients tell me, "My dentist never told me I had a missing tooth," or "My dentist told me not to bother about that missing tooth as it would never bother me." The tooth that does not erupt at its normal time may be entirely missing, or it may be present and never produce symptoms of discomfort referable to it; but, knowing as we do the trouble produced by such conditions, are we to be excused for not definitely determining conditions as they exist?

I have seen quite a number of cases of malignancy in the mouth, and of this number about forty were apparently produced by irritation arising from some form of denture over root fragments or unerupted teeth, chiefly upper and lower third molars. The absence of a tooth should never be taken for granted. We can prove its presence or absence with the roentgen ray. In such cases, we should not be satisfied with the intraoral film only, but a large extra-oral film should be made. Such a procedure should be followed wherever these conditions are present. It is embarrassing to learn that a patient for whom we have constructed a denture is afflicted with a deadly malady. To what extent are we responsible?

Approximately 7 per cent of all cases of malignancy occur in the tissues of the oral cavity. Is it not our duty to prevent, in every instance possible, this and all other diseases that prey on mankind?

If our examinations are complete and our best effort is put into each operation,

ere long we will gain the distinction of being real guardians of the public health, a distinction that is rightfully ours when we do our best, but to which we are not entitled until we do our best in every case.

DISCUSSION

William A. Cook, Detroit, Mich.: Dr. Hume reminds us that "The roentgen ray will never be more than an aid," but today its findings are the strongest link in our chain of evidence in diagnosis. I would rather take issue with Dr. Hume when he says, "I feel that every dentist should have access to a roentgen-ray machine and have a fair knowledge of the subject." I would emphasize that statement by saying, "Every dentist should have a broad knowledge of the subject." He should know the anatomy involved in the dental roentgen ray so that he can recognize the many normal anatomic variations. He should readily recognize the various formations of the antrums and not diagnose them as cysts and abscesses. He should not diagnose the tip of the coronoid process as an impacted upper third molar nor the mental foramen as an abscess on the lower bicuspids. In fact, for his own good, he should know the normal from the pathologic and be able to differentiate pathologic processes. Dentistry is now accepted and respected by the better element of the medical profession as a vital factor in health problems, and the better physicians are anxious to consult with the dentist as a specialist. The roentgen-ray evidence is by far the greatest factor in these consultations, and the dentist must know his subjects so that he can give of his knowledge rather than indulge in vagaries, if he is to keep faith with his patient, aid the physician and be a credit to his profession. To give this service, he must not only know the roentgen-ray evidence, but he must know the pathology, the bacteriology and the physiologic chemistry involved in his specialty. If he does not, it is better to admit it frankly and refer the physician to one who can give the required service. If the dentist fails in this consultation service, dentistry will be on dangerous grounds. If he fails, dentistry as a separate profession cannot continue, but will be taken over by the medical school, to become a specialty of medicine, and that would be a bad thing for medicine, dentistry and the laity. Dentistry can do greater things as a unit than it ever can as a specialty of medicine, but medicine already recognizes the great importance of dentistry and is planning to take it unto itself. Let us make it our business to know our subject. Dr. Hume advises us well when he warns us against telling our patient not to bother about the missing tooth, as it will never bother him. I interpret that to mean not only the missing tooth, but also the fractured roots, the sinuses opened by extraction and all the other abnormalities and pathologic conditions which the roentgen ray reveals or which we have knowledge of. We are not fulfilling our professional duty when we neglect to correct or to advise our patients of any condition that exists which may later give them trouble or, as Dr. Hume has brought out, be the source of malignancy and, in many cases, the cause of death. Another thing which I feel should be brought to the attention of this group under the head of roentgen ray is the many methods of numbering the teeth on dental diagrams used on reference cards, record cards and roentgenogram folders. A great many misunderstandings have arisen and many mistakes have been made because of the various designs and methods of numbering and marking dental charts. At the present time, there are no less than seven methods being used, and this causes a great deal of confusion. The profession would appreciate a standardization of the dental chart and is ready to use any good method that may be adopted. I suggest that this group recommend to the incoming President that he appoint a committee to approve of some method to be presented to the House of Delegates for adoption as the standard method of the A.D.A. of numbering the teeth on dental diagrams.

Dr. Hume (closing): Allow me to go a little more into detail in some of these cases of fractured roots, imbedded teeth and their combined effect where bridges or dentures of any type in which there is a saddle or appliance rest on the soft tissue. In my opinion, there is no better way of getting ourselves into trouble, serious trouble, than in that sort of thing, and for us to treat those things lightly is neglecting to do our

full duty. I have seen many of these cases and I sometimes feel that every member of the dental profession ought to have an opportunity to sit by the bedside in such cases and have the patient tell his story, and then in turn take it to himself. When we see people that require morphin or other drugs to ease them in their last few hours, we go back to our offices and not only look at the exposed surfaces of the teeth, but all the tissues of the mouth. We must see these cases and recognize them in the beginning, and if we do, we will surely find that the great percentage of them can be cured.

DENTAL SURVEY OF ONE THOUSAND ADULT MALES: A STATISTICAL STUDY CORRELATED WITH PHYSICAL AND LABORATORY FINDINGS*

By H. C. CRAMER, D.D.S., Milwaukee, Wis.

AN increasing interest in oral pathologic conditions has led to the advancement of many theories regarding their etiologic importance in systemic disease. How far actual statistics confirm the theories which have been advanced remains to be demonstrated. There is no doubt that many conditions are held to be of significance, because of incomplete knowledge, while, for the same reason, definite pathologic changes may be regarded as of no diagnostic importance. This being true, a careful statistical analysis of the occurrence of various types of dental abnormalities both in health and in disease is of importance. Such studies must eventually confirm or disprove our present teachings.

In any attempt to correlate dental findings with systemic disease, a thorough physical examination is fundamental. Positive deductions regarding such relationship based upon history alone or upon observations made by men untrained in physical diagnosis are dangerous. Individuals with the outward appearance of perfect health may have grave disturbances present. Any consideration of the subject which disregards such facts may be misleading, and must be looked on with skepticism.

The statistics here presented are of special interest because they comprise data from a fairly accurate cross-section of a working male population, who have been studied exhaustively from both the medical and the dental standpoint.

The group of 1,000 patients consisted of 341 executives and office workers, 247 skilled workers, 183 semiskilled workers, 224 unskilled laborers and five unclassified employes. No attempt has been made to separate these classes in the following report, and no observation in this respect worthy of note was made except that, as the economic status of the group declined, unsanitary dentistry and focal infection increased, until the unskilled laborer was reached. He had made no attempt to save his teeth, and had resorted to extraction as soon as he felt discomfort from them. This class

*From the Department of Preventive Medicine, A. O. Smith Corporation.

*Read before the Section on Histology, Physiology, Pathology, Bacteriology and Chemistry (Research), at the Sixty-Ninth Annual Session of the American Dental Association, Detroit, Mich., Oct. 25, 1927.

had less infection in the form of root abscesses, but a greater incidence of apparently active caries due to an accumulation of unfilled cavities.

The oral examinations were standardized, including full mouth roentgenograms, vitality tests, transillumination and clinical observation of mouth, teeth, adjacent glands and other contiguous tissues. History of devitalization and past symptoms or involvement were noted, and all were recorded as part of the general health examination.

TABLE 1.—INCIDENCE OF CARIES IN 1,000 CASES

Age Years	Patient	Restorations		Caries		Extractions	
		Total	Av. per Case	Total	Av. per Case	Total	Av. per Case
20—25	129	925	8.16	671	5.2	283	2.29
25—30	225	1660	7.38	1021	4.53	636	2.83
30—35	183	1423	7.7	676	3.7	646	3.53
35—40	167	1261	7.55	583	3.49	686	4.1
40—45	99	808	8.1	254	2.57	482	4.86
45—50	84	533	6.3	189	2.25	571	6.8
50—55	48	262	5.4	68	1.41	349	7.2
55—60	25	157	6.2	78	3.12	192	7.6
Above 60	30	88	2.9	60	2.	506	16.9
Total	1000	7117	7.11	3600	3.6	4351	4.35

CARIES

Since our study deals with adults only, it does not give a complete picture of the incidence of caries; but a rather interesting comparison of the periods of susceptibility and rapidity of tooth destruction may be made. We find in the first half of the third decade, the highest average of carious teeth (5.2 for each mouth) and the highest average of restored caries (8.16 for each mouth). From this age group on through the succeeding half decades, active caries gradually but steadily declines, save for the age group of 55 years, in which it increases slightly (Table 1) and subsequently declines again. If we consider carious, restored and extracted teeth as evidence of caries,[1] any combination of these which may be computed from these data gives a result similar to that noted for active caries. These observations, therefore, do not conform to the generally accepted age periods[2] of susceptibility to caries.

One hundred and forty-one cases of extensive caries, the total number of persons in the group having ten or more carious cavities, were studied for physical or laboratory signs which might be associated with this condition, and no significant correlation could be made.

TABLE 2.—INCIDENCE OF IMPACTIONS IN 1,000 CASES

Impactions	Cases		Teeth	
	No.	Per-cent	No.	Per Cent
Mandibular third molars	100	10.0	131	58.4
Maxillary third molars	78	7.8	93	45.3
Third molars	153	15.3	224	88.9
Cuspids	14	1.4	15	8.8
Bicuspids	5	0.5	6	3.4
Total	172	17.2	245	100.0

IMPACTED TEETH

I was unable to find in the literature definite data regarding the incidence of impacted teeth, and it was somewhat of a surprise to find impactions in 17.2 per cent of the group (Table 2). In

1. Mummery, J. H.: Brit. Dent. J., 11: 288-291, 1890.

2. Burchard, H. H., and Inglish, O. E.: Dental Pathology and Therapeutics, Ed. 6, Philadelphia: Lea & Febiger, p. 267, 1920.

this tabulation, no third molar was considered impacted in a person under 30 years of age unless it was lying in such a manner that eruption was impossible. In the later ages, all imbedded teeth were included, regardless of position. While a few of these might erupt in the course of time, the number would be insignificant, and their progress would have been so far interfered with that it might be considered abnormal.

The majority of impacted teeth were third molars, and it was felt that the dissimilarity between those in the maxilla and those in the mandible required separation of the two in this summary.

Mandibular impacted third molars are perhaps of most interest because of the difficulty of their removal, and the fact that they are more often subject to acute pathologic involvement. This type was present in 10 per cent of cases and comprised 58.4 per cent of the third molars so involved. The maxillary third molar was impacted in 7.8 per cent of cases, and the sum of the two formed a total of 88.9 per cent of all impactions. There was a tendency for impactions to be multiple, and the reader will note a consequent overlapping of case percentages (Table 2). Further analysis of third molar abnormalities will be given in a later paper.

The number of cuspid and bicuspid impactions in 1,000 patients is too small to give reliable percentages, but I believe Table 2 shows a relatively true case incidence. More data are being collected to substantiate this.

ROOT CANAL FILLINGS

Roentgenographic reading of 14,000 films, plus necessary retakes covering 32,000 alveoli, or, in other words, full dentures of the entire group were tabulated. The 14,000 films include the routine fourteen films of each mouth, and when there was an obscure apex of a pulpless tooth or a questionable area of bone, two or more new films were made. In a study of these roentgenograms, an attempt was made to distinguish between all pulpless teeth and those which had been root filled. Of the former, there were 2,430, and of the latter, 1,936. The difference of 494 represents teeth whose pulps had died from traumatism or thermal shock, from extensive caries or other injury, and 199 root fragments. Of the 1,936 root filled teeth, 1,508 had imperfect care, with less than three-quarters of the linear dimension of the root canals filled. Of these, 64.5 per cent had apical decalcification, while of 378 teeth which were more than three-quarters root filled (about 3 mm. of canal at the apex unfilled), 56.1 per cent were decalcified.

TABLE 3.—RESULT OF AVERAGE ROOT FILLING

Pulpless Teeth	Single Rooted Teeth	Double Rooted Teeth	Apical Decalcification	Per Cent Apical Decalcification
Root filling imperfect	907	1025	1247	64.5
Root filling—3 mm.	226	152	163	56.1
Root filling to apex	104	16	60	55.5

There were 120 teeth with apparently thoroughly filled root canals, and of these, 55.5 per cent had decalcification about the apex, the incidence differing but slightly from those with a small extent of open apical canal. Table 3 shows the comparison between double and single rooted teeth, the latter being naturally more often thoroughly filled.

This evidence of the failure of root canal filling must not be considered a

measure of the efficacy of this treatment by an especially skilled clinician. It *does* show the conditions found in a representative group, treated in the main by average practitioners in nearly every state in the union.

While the percentage of decalcification about root canals filled to the apex differs from the findings of Black[3] (8 per cent) and of Puterbaugh[4] (12 per cent), many of the teeth reported by the former were filled by himself, and treatment of the group unquestionably represented a much higher degree of clinical skill. Puterbaugh presented a group from a school clinic with an average lapse of considerably less than three years between root filling and the subsequent examination reported. The canals in his series were subjected to roentgenographic inspection before and after treatment, and a number of abcessed teeth rejected as unsuitable for filling. My observation has been that, in the average practice, roentgenographic selection and control in root canal work is the exception.

ROENTGEN-RAY PATHOLOGY

Of the 1,000 patients, 684 had pulpless teeth. Many of the individuals in this group had never visited a dentist and had no need for dental attention. Such cases would not have come to my notice had not this service been a routine of the health examination. This fact tends to lower the case incidence of all abnormalities, but gives more accurate averages, which explains in part the difference in percentage of pulpless teeth, here 68.4, from that found by Haden[5] (91 per cent) in a report of 500 cases. Also, considering the number of missing teeth in his group (6.4 for each person) and referring to Table 1, I conclude that he may have been dealing with a group averaging considerably over 40 years of age, while the average age of this group was 34.9 years, a time at which the prevalence of pulpless teeth is less than in later life. These conditions would also affect the number of pulpless teeth for each person, 3.9 in Haden's group, as compared with 2.43 in this. Black, reporting on 600 adults, found 3.1 pulpless teeth for each person, with an average of 26.5 teeth present in each mouth. In the three surveys, the average number of rarefied areas for each mouth was almost the same: Haden, 1.5; Black, 1.4, and the present group, 1.47.

Table 4.—Roentgen-Ray Abnormalities In One Thousand Cases

	No. of Teeth	No. of Cases	Per Cent Cases	Av. per Case
Pulpless teeth	2,430	684	68.4	2.43
Root filled teeth	1,936	593	59.3	1.93
Periapical decalcification	1,470	564	56.4	1.47
Subgingival decalcification		511	51.1	
Residual decalcification	32	32	3.2	0.03
Surgical root fragments	199	139	13.9	0.19
Periapical osteosclerosis		254	25.4	

Regardless of individual opinions as to methods of treatment, members of both the medical and the dental profession agree that circumscribed infection

3. Black, A. D.: Clinical Studies of Pulp Treatments, Including Report of Fifty-One Cases in Which Dead Pulps Were Improved, J. N. D. A., 8:132-140 (Feb.) 1921. J. A. M. A., 71:1279, 1918.

4. Puterbaugh, P. G.: Pulp Canal Therapeutics, J. A. D. A., 13:1384-1391 (Oct.) 1926.

5. Haden, R. L.: Incidence of Pulpless Teeth, J. A. D. A., 11:730 (Aug.) 1924.

about teeth may cause systemic disease. In the light of such convictions, the high incidence of infection shown here must be looked on with grave concern.

In considering the presence of root fragments and residual infection, one is interested to know the result of present methods of extraction in relation to eradication of foci. A search of the literature brought to light several reports giving case incidence, but as the number of edentulous areas was not given, there was no adequate basis for comparison.

Cook,[6] in a report covering 500 edentulous and partially edentulous mouths from the Mayo Clinic, found 25 per cent with root fragments. He was dealing with a much higher number of edentulous areas for each mouth than was present in this group, in which 13.9 per cent of cases had root fragments with an average of 4.35 extractions for each case.

Eusterman[7] reported 290 cases, mainly of edentulous mouths, eighty-nine of which had a total of 129 root fragments, or a case average of 0.44, as compared with 0.19 in this series. Gross evidence of residual infection in his group (3.1 per cent) corresponded closely to our figure of 3.2 per cent (Table 4).

Of the 4,351 edentulous areas in the group which I observed, 199 contained root fragments. Taking, in addition, the thirty-two areas of residual infection present, we have definite evidence of failure in 5.3 of each 100 extractions.

The term periapical osteosclerosis as used in these tables designates an abnormal thickening or a deposit of lime salts in the bone trabeculae, radiating from the apex of a pulpless tooth or the border of a decalcified area.[8] Tabulation of this condition was made only in such cases as were easily differentiated in the roentgenogram, and which were apparently due to an inflammatory process of infectious origin. This type, of which there were 254 cases, is generally quite readily distinguished by an experienced observer from that resulting from stress or traumatism, particularly when the condition is marked. Such cases will be considered later in this paper.

SYSTEMIC REACTIONS

Several attempts have been made in the past to demonstrate the presence or absence of dental infection through changes in the blood picture.[9] These attempts have met with but meager success, and with our present knowledge of reaction, in the blood, to infection, only rather broad evidence can be expected. In the present study, there was a tendency to leukocytosis in the presence of dental infection, and leukocytosis was more frequent in cases having marked signs of this infection. Relative lymphocytosis also was present more often than in the absence of infection. These findings were far from constant and cannot be relied on in individual cases. Analysis of the blood counts will be dealt with in a later article.

A study of the physical findings in the presence of focal infection, Squier found a tendency to disturbance in the heart response to exercise. Also, in cases of chronic infection, he found a high incidence of albumin and casts in the urine.

6. Cook, T. J.: Dent. Cosmos, 69: 349-351 (April) 1927.

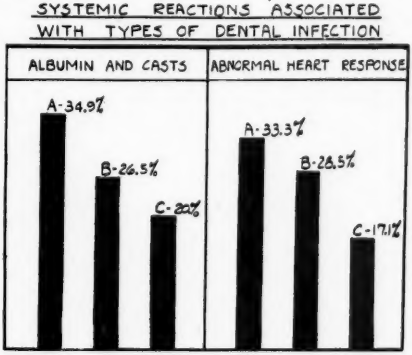
7. Eusterman, M. F.: Dent. Cosmos, 63: 901-903 (Sept.) 1921.

8. Pollia, J. A.: Items Int., 49: 781-788 (Oct.) 1927.

9. Toren, J. A.: Dent. Cosmos, 64:917 (Sept.) 1922. Haden, R. L.: Differential Leucocyte Count in Chronic Periapical Dental Infection, J.A.D.A., 10: 596 (July) 1923. Hecker, F.: Am. J. M. Sc. Logan, W. H. G.: J. Allied Dent. Soc., 11: 156, 1916.

In order to study the relation of oral infection to these phenomena, I selected cases with three distinct types of pulpless teeth, Type C consisting of those which were all negative on examination by roentgen-ray, Type B, those with periapical decalcification, and Type A, cases with periapical osteosclerosis. That there might be no confusion from border-line cases, and that the study might be a fair comparison, only marked conditions were selected.

The accompanying graph shows the incidence of these phenomena in the presence of teeth with apical osteosclerosis (A) and with apical decalcification (B); also in pulpless teeth that were negative on roentgen-ray examination (C).



Incidence of systemic reactions in the presence of teeth with apical osteosclerosis (*A*) and with apical decalcification (*B*); also with pulpless teeth that were negative on roentgen-ray examination (*C*).

Of the 648 cases having pulpless teeth, there were seventy in which the apices of these teeth were clearly shown in the roentgenogram, the lamina dura was defined throughout and there was no evidence of disturbance. This group (C) was of an average age of 33.8 years. The pulpless teeth had been devitalized for an average of 8.6 years. Albumin and casts were present in the urine of 20 per cent, and the heart response was abnormal in 17.1 per cent.

Markedly decalcified areas without visible evidence of osteosclerosis are, in general, rather less numerous, but, of these, there were forty-nine cases, composing Type B. The average age was 36.3 years and the length of time of devitalization average, 10.3 years. Albumin and casts were present in 26.5 per cent, and there was an abnormal heart response in 28.5 per cent.

Type A consisted of sixty-three extensive osteoscleroses of infectious origin. The combined ages averaged 34.6 years and the period of devitalization averaged nine and nine-tenths years. In this group, the cases showing albumin and casts in the urine totaled 34.9 per cent, and the heart response was abnormal in 33.3 per cent, nearly twice the percentages found in the group with teeth that were negative on roentgen-ray examination (Type C), and a considerable increase over those with extensive decalcification (Type B).

The importance of these systemic reactions cannot be fully estimated here, but irritations of such a nature continued over a period of years must be harmful, and their increasing incidence in the presence of apparently more virulent dental infection should stimulate further investigation.

These series are small, and larger groups must be studied; but comparison seems to indicate an increased virulence of infection in patients when osteosclerosis is present, as compared with those having only apical decalcification or teeth appearing negative in the roentgenogram; and that the signs of bone reaction displayed here have a demonstrable diagnostic significance.

While extensive areas of periapical decalcification are looked on as, to some degree, a measure of the danger, osteosclerosis as such a measure has not been so generally accepted. Observation from a bacteriologic standpoint, and a study of these cases, have convinced me that this sign is one of the most significant in the evaluation of dental infection.

REGENERATION OF THE GINGIVAE FOLLOWING SURGICAL TREATMENT OF PYORRHEA WITH SPECIAL REFERENCE TO THE EPITHELIUM*

By G. R. LUNDQUIST, D.D.S., Chicago, Ill.

A RECENT article by Joseph M. Thuringer on "Regeneration of Stratified Squamous Epithelium" calls attention to the fact that biologists in general have attempted to establish the method of cell division rather than to study regeneration in any particular tissue.

Such men as Fleming, Pftzner and Unna, as well as biologists in general, are reasonably well agreed that the cells arise from the stratum germinativum and are pushed peripherally, become differentiated and assume, in turn, the characteristics of cells of the particular layer which they occupy. The various opinions of these authors can be expressed thus: 1. Only the basal layer of columnar cells is actively engaged in reproduction. 2. The lowest layers are the stratum germinativum. 3. The basal layer plus the one or two layers of the stratum spinosum immediately adjacent make up the stratum germinativum. (Polygonal.)

Dr. Thuringer's contention is that mitosis does occur in some of the layers that are farther from the periphery. He gives apparently adequate statistics to substantiate his point of view.

In an attempt to make an analysis that would reconcile Dr. Thuringer's findings with the varying opinion expressed in the classification just referred to, human gum tissue was selected for study subsequent to the "surgical treatment of pyorrhea."

The material used consists of sections of tissue subsequently removed from the operative areas previously referred to in the "treatment of pyorrhea," at intervals of ten, fourteen, forty-two and sixty days.

The sections of tissue thus removed from the interproximal spaces were fixed in picroformol solution and acetic acid to bring out the nuclear structures. Each section was then dehydrated, blocked in paraffin and stained according to Haidenhain's method with iron hematolyn to define the nuclei and their constituents more clearly.

After the sections of tissue were stained, an analysis of the material was made from two points of view: (1)

*Read before the Section on Histology, Physiology, Pathology, Bacteriology and Chemistry (Research) at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 23, 1928.

method of cell reproduction (mitotic or amitotic) and (2) regenerative process.

The method of reproduction proved to be a mitotic process of cell division. Prophase, metaphase, anaphase and tetophase stages were clearly distinguished.

Further, it was observed that there were mitotic figures in layers from six to seven or even eight layers peripherally to the stratum germinativum. In this, our findings agree with Dr. Thuringer's.

In the last twelve sections examined, there were thirty-five figures in the prophase stage of mitosis, exemplified by spiremes, in the stratum germinativum or cylindricum basal germinal layer. Further, there were twelve spiremes expressed in the second germinal layer or stratum spinosem, six spiremes in the third layer, still the stratum spinosem. Again, it is to be observed that three spiremes were found in the fourth layer, and three in the fifth were also noted.

Furthermore, in these twelve sections, there were found ten mitotic metaphase figures in the first layer; seven in the second; ten in the third; nine in the fourth layer; six in the fifth, and one in the eighth.

As regards the anaphase stage, there were seven anaphase figures in the first layer or stratum germinativum, three in the fourth layer from the basal layer and one in the sixth.

The last stage, tetophase, bordering on complete division figures, revealed two in the second layer, two in the fourth and one in the fifth.

SUMMARY

Mitotic figures are most plentiful in the basal layers or those comprising germinativum, consisting of stratum cylindricum and lucidium. Further, it can be observed that layers lying peripherally to the basal layers up to the eighth or perhaps farther do show mitotic figures, as stated by Dr. Thuringer.

However, most of the early mitotic figures are found in or near the stratum germinativum, as well as many of the more advanced mitotic figures. Thus, the contention of the biologists in general that cells do move peripherally from the germinal layers is not at variance with either Dr. Thuringer's or our findings. Perhaps the qualification that the stratum germinativum should consist of more than one layer would make such reasoning more in accordance with the facts.

Our other avenue of study was an analysis as regards the regenerative process. Here, we had supposed that, after a gum resection, the alveolar process would be covered with a blood clot, then, by normal granulation tissue, and it in turn with a single layer of epithelium, stratum germinativum, which would multiply and push cells peripherally after building laterally.

The stratum germinativum may be from one to six layers thick at the margin and, as the epithelium grows from labial to lingual or lingual to buccal at the end of two weeks, four weeks or six weeks, the covering is from eight to ten layers thick. In those cases in which, by gross examination, it appears that no epithelium has formed, it can be demonstrated, even as early as ten days after operation, that regeneration consisting of five or six layers in thickness has taken place on the labial and lingual peripheral margins.

MONSON TECHNIC FOR FULL DENTURE CONSTRUCTION*

By R. G. KEYWORTH, D.D.S., St. Paul, Minn.

THE Monson technic for full denture construction is unlike other technics in its very principles, as it is based upon the spherical principle of occlusion, the result of research by George S. Monson.

All technics should be based upon definite principles. The various steps of this technic will be stressed in relation to the Monson principles. In other words, each step in this technic has a true value and a definite reason for its use in relation to the spherical principle. While certain points are stressed which may seem of minor importance, they are nevertheless of value in their aggregate effect on the finished result. Keen observation and experience with the technic will demonstrate the significance of the points herein stressed.

The first step is a thorough and careful examination of the tissues upon which the denture is to be seated. In this must be included an examination of the ridge, upper and lower, noting the height, thickness and general outline, with the thought in mind of securing a correctly fitting tray; the junction of the hard and soft palates and the position of the retromolar fossa, to determine where the posterior denture line is to be; the vault of the mouth, whether high or flat, to determine whether the tray will have to be built up in the palate or flattened out; the tissue and muscle attachments, high or low, and the position of the mylohyoid ridge, so that the tray can be fitted without impingement. A knowledge of these points and any irregularities which may exist will aid materially in the proper fitting of the impression tray.

FITTING THE UPPER IMPRESSION TRAY

A Britannia metal tray is selected because of its rigidity. It is heavy and will not change its form when necessary pressure is exerted on it in taking the impression, as a thin aluminum tray is apt to do. This tray is used throughout the entire step of impression taking and not merely as a carrier for the material to be then removed, as in some technics. (Fig. 1.)

The center of the under or oral side of the tray is cross-scored with a sharp knife to provide a finger rest. The tray must be trimmed free of all muscle and tissue attachments so that there is no displacement of these attachments by the rim. The heel of the tray should extend slightly posteriorly to the junction of the hard and soft palates. When properly fitted, the entire tray should permit of approximately 5 mm. of impression material between the tray and the tissue when the final impression is seated. If there is a much greater thickness than

*Read before the Section on Full Denture Prosthesis at the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 21, 1928.

this, the excess will cause an excessive displacement of soft tissue and there will not be an even distribution of compound over the entire area.

If the vault of the mouth is too high for a regular type of tray, the center of the tray should be built up with black tray compound, and an impression taken of the vault having the bare tray seated on the ridges. This insures the proper thickness of material in this location in the final impression.

There are two fundamental principles to be observed in the use of compound as an impression material. First, the tray should be fitted so that there will be a definite and uniform thickness of compound in the finished impression, and, secondly, the force applied in taking the impression must be in a predetermined straight line, with no shifting of direction, and must be maintained until the material is chilled.

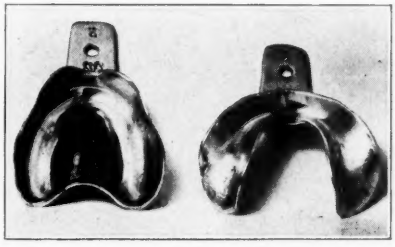


Fig. 1.—Fitted Britannia metal trays.

There is a compression of tissue under a denture, from the force of occlusion, and it is necessary, for maximum stability during mastication, that the denture shall accurately conform to the tissue in the compressed state. It is equally necessary, for the health and preservation of the tissues under the denture, that there be a minimum of compression during the rest periods. In other words, the ideal impression is one that will produce a denture that fits tightly under the stress of occlusion, but springs free and adheres gently to the tissue when pressure is released.

Upper Impression Technic.—This impression technic is solely a modeling compound technic. A combination of one cake of black tray compound and one cake of perfection compound is placed in a water bath at approximately 150 F. and thoroughly mixed. When sufficiently mixed, this composition provides a homogeneous mass of uniform color, which is then kept in the water bath at 140 F., which maintains the compound at the proper working consistency. This combination gives the best known impression material for securing details of the mouth, and, at the same time, provides necessary resistance for correct compression of the tissues.

Fig. 2.—Direction of force for taking upper impression.

Test Impression.—With the impression compound of the proper consistency, a test impression is taken by distributing the required amount of compound evenly over the tray and inserting the tray in the mouth. This test impression, when seated, can be immediately removed, for

its purpose is to determine whether the tray is properly fitted, i.e., whether there is an amount of material approaching 5 mm. in thickness, to which attention was called in the fitting of the tray, and also to note the boundaries of the impression tray in relation to the movable tissues. If there is an excess of material, remove it; if too little, add a portion of the soft compound, remove the entire mass from the tray, reheat and take another test impression. The tray may require better adaptation to the tissue; if so, make the change before taking the final impression.

Fig. 3.—Finished upper impression showing area of relief.

Let this test impression in no sense be confused with the snap impression, with which many are familiar. The material of the test impression is not corrected, but is removed from the tray and reheated for the final impression. That distinction should be clearly understood.

Final Impression.—Having made certain that the tray is properly adapted and that there is the correct amount of material for the upper impression, softened and reheated in the water bath, the operator can take the final impression.

Determine the approximate center of the palate of the patient, for pressure is to be exerted on the tray over this point with the middle finger resting on the scored portion of the tray.

The impression compound of the test impression, which has been reheated, is uniformly distributed in the tray, and molded with the fingers to approximate the shape of the palate and ridges. It is quickly passed over the flame to reheat the surface, dipped in the hot water bath to temper and carried to the mouth. It is placed with the anterior rim of the tray one-half inch forward of the anterior ridge and centered. (Fig. 2.) From 10 to 15 pounds pressure is applied in the center of the palatal area, upward and slightly backward, following the slant of the nose, all pressure being applied by the middle finger in the center of the tray only. For better adaptation of the margin, the cheek and lip are molded down with the free hand.

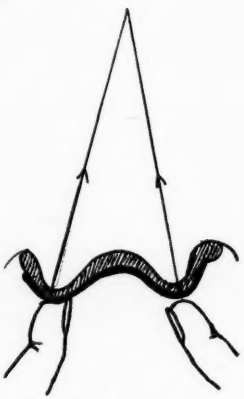


Fig. 4.—Direction of force for testing an upper impression.

The pressure is maintained in the center of the tray without changing posi-

tion or direction until the compound is thoroughly chilled, either by a flow of ice water from the syringe or by folded napkins dipped in ice water and applied to the base of the tray by the assistant. Any change of direction of force during this process will cause a failure of the impression. The maintenance of this constant amount and direction of force requires the undivided attention of the operator, and any diversion such as an attempt to chill the impression with the free hand will cause distortion. The pressure in the center of the tray equalizes the mass of impression material, causing it to flow equally in all directions, with

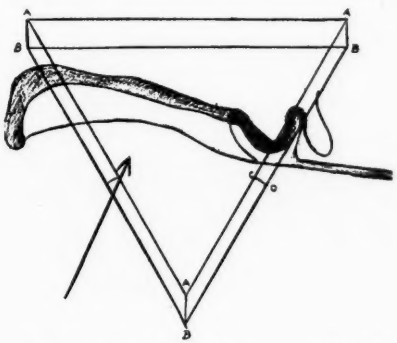


Fig. 5.—Direction of force applied in taking the lower impression.

equal compression of all tissues of the seating area, provided the material is properly confined in a correctly fitted tray. When the compound material is chilled, the impression is removed along the same lines that it was inserted.

Trimming of Impression and Relief.—(Fig. 3.) The excess compound overhanging buccal and labial flanges of the tray should be trimmed away. Any excess over the posterior margin from tuberosity to tuberosity is also removed and the impression trimmed to a line 5 mm. posteriorly to the junction of the hard and soft palates. To determine the location of the junction of the hard and soft palates, the junction in the mouth is marked with an indelible pencil. Then, when the dried impression is seated in the mouth, this marking will be transferred to the impression. This marking should be accentuated by scratching with a fine sharp instrument so that it will appear definitely on the plaster cast, and indicate the position of the posterior denture line.

At this stage, it is advisable to anticipate the rocking of the denture on the hard palate under occlusal stress; therefore, the impression should be relieved

Fig. 6.—Finished lower impression showing area of relief.

by scraping. The impression is the basis for the finished denture and should be prepared to meet the requirements of that denture in adaptation. Under occlusal stress, the soft areas are compressed, and this causes riding of the denture on the hard areas. It is therefore necessary to relieve the palatal area, so that when there is a bolus of food on one side only, the compression of the tissue by masticating stress will not cause

a rocking or tipping of the denture. To obtain this relief, a No. 5 sharp Kingsley scraper is used, starting at a point in the medium line about 10 mm. posteriorly to the crest of the anterior ridge and scraping the impression posteriorly to within 5 mm. of the junction of the hard and soft palates, to a depth of approximately 0.5 mm. in the center, in the average case. We then relieve the impression laterally on each side to within 8 mm. of the crest of the ridge, graduating the depth of the scraping to a feather edge. In cases which have quite extensive hard areas or definite spinous portions, the depth and extent of the relief should be varied to suit the conditions. In the average case, from 0.5 to 1 mm. is sufficient depth. Irregular shaped and unusual hard areas should be outlined in the mouth with an indelible pencil and the outline transferred to the impression by seating the impression in the mouth. In this way, the outline will be printed on the impression.

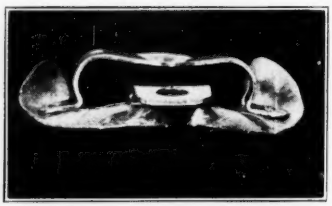


Fig. 7.—Sahr equalizing tray.

Testing the Impression.—(Fig. 4.) The impression is now ready to be tried in the mouth, to determine whether or not the desired adaptation has been secured. It is inserted and seated in the same manner in which the impression was taken, the same force being exerted in the same position and direction. When seated, if air is forced out at the heel of the impression and the impression resists dislodgment, there is proper adaptation of the material to the tissue. As a further test, pressure is exerted with one finger on the base of the tray over the ridge in the bicuspid and molar regions, on a line corresponding to the force of mastication, i.e., upward and inward toward the crista galli, which is in the median line 1 inch posteriorly to the surface on a level with the superciliary ridges. Test each side separately. If there is rocking of the impression, the relief has not been sufficient or has been incorrectly located. A dislodgment or lack of atmospheric pressure indicates a shifting of the direction of force during the impression taking. To proceed with this impression would be to invite failure in the final result.

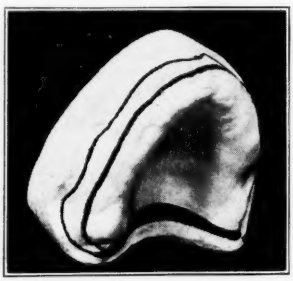


Fig. 8.—Denture line and area of relief for valve seal and postdam.

This technic provides a means of checking each step as it is completed, and of recognizing errors before going to the next step.

FITTING OF THE LOWER IMPRESSION TRAY

In the lower case, the Britannia metal tray is used for the same reason as in the upper. It is desired that as much area be covered with the lower denture as the tissue will tolerate. Therefore, the tray should be long enough to include at least

half of the retromolar triangle, and extend laterally as far as the muscle attachments will permit. Often, there is quite an extensive flat area buccally to

Fig. 9.—Finished baseplate with rolled rim.

the crest of the ridge in the molar region, which provides a very stable base for the lower denture. In order to utilize this base, the buccal flanges of the impression tray, in the molar region, are bent out to a horizontal position to permit the impression material to take an equalized impression of this area. When the tray is fitted, it should permit of having about 5 mm. of material between the tray and the tissue in the completed impression.

Lower Impression Technic. — The modeling compound used is the same as is used in taking the upper impression. A suitable amount is distributed in the tray and a test impression taken as in the upper, and for the same reasons.

With the lower tray fitted correctly and the proper amount of compound selected and reheated, the final lower impression is taken. The compound having been distributed in the tray and molded to approximately the contour of a finished impression, the surface reheated over a flame and then tempered in the hot water bath, the tray is placed in the mouth and centered over the ridge. Placing the index finger of each hand on the tray in the region of the second bicuspids, and with the thumbs under the mandible, we exert about 4 pounds pressure on a line downward and slightly forward. (Fig. 5.) This should be a continuation of the lines of force used

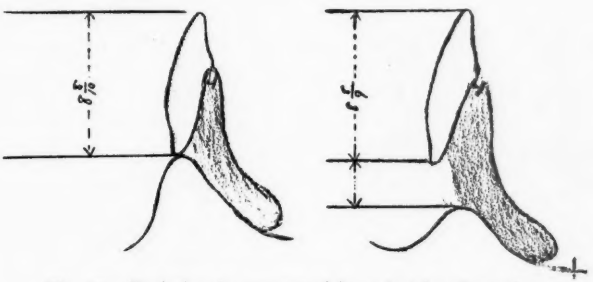


Fig. 10.—Variation in amount of bone lost by absorption.

in taking the upper impression. The tray is chilled with the ice water as was the upper, and then removed along the same line as it was inserted. The lower impression requires less pressure to secure equal compression of the tissues because of the lesser area to be compressed.

The periphery of this impression is trimmed to the tray by removing all excess compound overhanging the flanges, as in the upper. (Fig. 6.) Then with a sharp No. 1 Kingsley scraper the impression is relieved for 0.5 mm. in depth on the crest of the ridge, being finished in a feather edge as the crest of the ridge is

left. This relief is made from a point representing the distal surface of the cuspid, and extending posteriorly to the distal surface of the first molar. Relief is given on both sides. This area is relieved because it is the lowest point in the arc and receives the greatest stress during mastication.

The Sahr equalizing tray has been designed for this type of impression. (Fig. 7.) In the use of this tray, the pressure is applied in the center of the seating area and is equally distributed over that area. This tray has the disadvantage of being more difficult to adapt, and while it is made in four sizes, there are some cases for which it cannot be correctly fitted.

Fig. 11.—Occlusal rims with spherical surfaces.

Testing the Lower Impression.—The impression, when trimmed, is tried in the mouth and tested for atmospheric pressure, also as to whether or not it will resist dislodgment by tipping, when pressure is applied on one side only. In making the test for tipping, pressure should be applied on one side at a time and in the direction which the lower posterior teeth are to assume when set up, that is, downward and outward. This provides a check on the work so far accomplished, and if there is not stability and retention of the impression in the mouth, there will be none in the finished denture. Too much emphasis cannot be made on the value of being able to recognize errors before proceeding further. The testing of the impression reduces the possibility of error to a minimum. If a satisfactory test cannot be obtained, a new impression should be made.

An all-compound impression is advocated because that material has certain properties which make it superior to plaster, or compound and plaster in combination. The compound impression can be tested so that the adaptation of the finished denture is known before proceeding with the balance of the technic. Compound is an active material and, if properly manipulated, is capable of transmitting an equalized pressure to the tissues. This provides for a firm seating of the denture under masticating and a release of the compression when at rest. The denture made from a plaster impression, and sealed in the soft transient tissues of the buccal cavity, obviates any

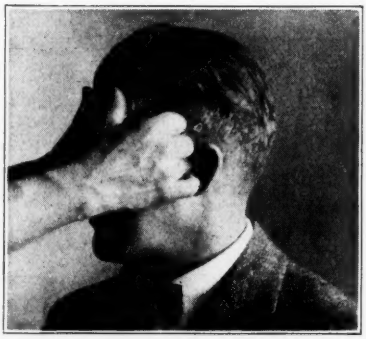


Fig. 12.—Condyle test.

possibility of a lateral range or grinding action in mastication, because of the lateral shift of the dentures. This can be readily demonstrated by placing a thin blade between the central incisors of such a denture. It will be found that the denture can be shifted laterally from 5 to 6 mm. without breaking the seal, a distance greater than the normal lateral range.

The Monson technic demands exactness, as does any procedure which produces satisfactory results, but this exactness is in no greater degree than any other technic unfamiliar to its user. When its principles and rudiments have been grasped, its simplicity and ease of adaptability to each individual are evident.

Fig. 13.—Pin for reestablishing centric relation.

MATERIAL FOR CASTS

Plaster of Paris is recommended for making casts on which to vulcanize. For metal dentures, one of the artificial stones or cement preparations can be used. For the best results in plaster casts, select a plaster made from a Nova Scotia gypsum with a known, tested crushing strength. Such a plaster, not too finely ground, makes a very hard cast and one that retains its hardness during and after vulcanization, cooling with a minimum amount of shrinkage.

To obtain uniform results in mixing plaster of Paris, definite quantities of liquid and plaster should be used. When plaster of Paris is mixed with water, it becomes fully hydrated and crystallizes out, forming a network of crystals; and as more of the plaster becomes fully hydrated, it in turn crystallizes out, increasing the solidity of the set by the interlacing of new crystals with those already formed. In this way, the cycle of reactions goes on until all of the plaster becomes fully hydrated and crystallized. An excess of water retards the mass from setting and renders it more plastic, and the interlacing of the crystals is not sharp and well defined, giving a cast that is soft and powdery with a low crushing property.

To hasten the setting of the plaster mix, an accelerator is used. A convenient

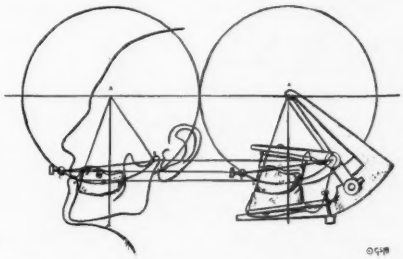


Fig. 14.—Transfer of occlusal rims in centric relation from the mouth to the instrument.

way to employ an accelerator is to dissolve one-half teaspoonful of potassium sulphate in one pint of water, by using one part of this solution to two parts of plaster of Paris by volume, a mix resulting that is about the right consistency and proper density. Sometimes, a little more plaster must be added, this depending on the amount of water of crystallization already in the plaster. This can be determined by making a test mix with each new batch of plaster.

The metal measuring device that comes with Taggart's inlay investment can be used to advantage. The large

bowl is filled twice with the accelerator solution and four times with the plaster of Paris. This will be the amount and proportion necessary to pour one impression.

After the impressions have been prepared, they should be poured at once. About twenty-five minutes is allowed for the plaster to become thoroughly set before removing the compound from the cast. The cast and impression are placed in cold water and the cast is allowed to become fully soaked. This moistens and

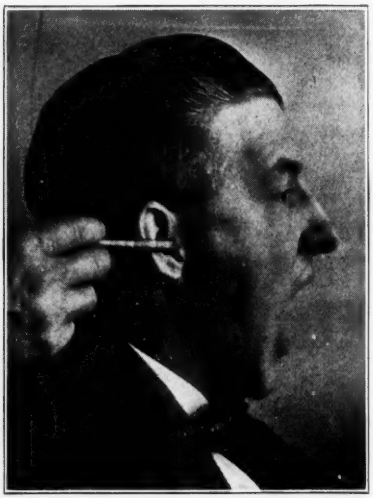


Fig. 15.—Locating the condyle.

chills the cast so that when it is placed in hot water to soften the compound, the compound will not stick to the plaster. It also chills the tray so that it can be removed from the impression by tapping. Never attempt to remove an impression tray from compound by heating. The cast and impression are then placed in hot water, which allows the compound to soften enough to be removed.

Preparation of the Cast.—(Fig. 8.) After separating the upper cast, a line is scribed on the greatest convexity of the ridge with a soft lead pencil (not indelible), held at right angles to the total seating area, this area being relatively the total horizontal area. This line is continued around the cast, back of the tuberosities and across the posterior at the junction of the hard and soft palate.

While the cast is moist or green the

Fig. 16.—Arbitrary location of the condyle.

ridge is lightly scraped to a depth of 0.5 mm., following the pencil mark, with a No. 5 Kingsley scraper. This produces a sealing in from immovable tissues rather than in the transient tissues at the rim of the denture. The scraping is continued back of the tuberosities and across the posterior part of the cast, making the relief area across the palate 5 mm. in

width and 0.5 mm. in depth. This entire relief is equivalent to valve sealing and postdamming. There is no preparation necessary on the lower cast.

We then scribe the denture line on the cast with a soft lead pencil, making the denture of such height that it will be free from impinging on the muscles and frenum, or from interfering with the tissues of the cheek. The position of this line is indicated by the inner angle of the peripheral border of the impression.

BASEPLATES

The purpose of the baseplate is to act as a carrier for the occlusal rim in establishing the jaw relationship and to hold the teeth in the wax set up for trying in.

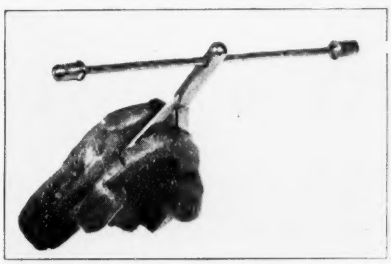


Fig. 17.—Equalizing wax and transfer plate attached to upper occlusal rim.

Accuracy in recording the jaw relationship, and the success of all subsequent steps in denture construction, depend primarily on the stability of the baseplates in the mouth. This requires a baseplate material which permits of perfect adaptation, and which is sufficiently rigid to withstand biting stress without fracture or change of shape at mouth temperature. A vulcanite baseplate meets these requirements best. "Graft's" baseplate material, if accurately adapted, can be successfully used.

Adapting Graft's Baseplates.—(Fig. 9.) The cast is thoroughly moistened to prevent the baseplate material from sticking. The baseplate is slowly heated over a low flame until the material is thoroughly softened, and is adapted to the palatal area of the upper cast, this first adaptation being extended to the crest of the ridges. When this has cooled until it is rigid, the rim is reheated on one side and adapted in the same manner. Then we proceed with the opposite side and the labial surface. When completely adapted without folding or buckling the rim is slightly warmed and trimmed with curved shears. The rim is allowed to project 3 mm. over the denture line so that, when finally adapted, the excess material can be softened and rolled back so as to produce a rounded margin

Fig. 18.—Transfer bow adjusted to condyle marking.

The lower baseplate is adapted in the same manner except that the first area of adaptation is made over the crest of the ridge in the anterior portion only.

It should be the aim of the operator to produce a finished baseplate of neat appearance and free from all wrinkles. There should be uniform thickness of

material approximately the thickness of the finished denture. to obviate any unnecessary polishing.

PREPARATION OF THE OCCLUSAL RIMS

In consideration of the next step (Fig. 10), it is well to remember that the jaw relationship is maintained by the teeth and it is necessary to supply a prop to take the place of the teeth in reestablishing that lost relationship. For this purpose, a hard wax is attached to the baseplates and is known as the occlusal rims or bite-blocks. As the function of the occlusal rims is to replace the lost natural teeth, they should occupy the position and have the bulk of the natural teeth plus the amount of bone absorption. For this reason, the operator should have a clear conception of the amount of tissue that has been lost, both tooth structure and bone structure, before building the occlusal rims. The amount of lost tooth structure can be quite definitely determined by Dr. Black's average measurement of the crowns of the anterior teeth, which is 8.8 mm.; but the amount of bone absorption, which also must be added, is an estimation, and is a matter of judgment. This judgment is dependent on keen observation and experience. To start with, each occlusal rim should be built to a height of 12 mm., as a safe average. This dimension is checked in the mouth by means of the condyle test, which will be explained later. With the occlusal rims of correct length, neatly and securely attached to the baseplates, attention is directed to the occlusal surface. (Fig. 11.)

If an examination is made of casts of the natural teeth, it will be noted that the occlusal surfaces of these teeth conform, in general, to the surface of an 8-inch sphere, both anteroposteriorly and buccolingually. Therefore, if we expect the occlusal rims to perform the functions of the teeth, even temporarily, they also must conform to that same spherical surface. This spherical surface can be obtained by carving the occlusal surface of the lower rim to fit a segment of an 8-inch sphere; or a more accurate method is to use a metal spherical segment as a hot plate. After the lower is so carved, the upper wax is softened in warm water, adapted to the lower occlusal surface and attached to the upper baseplate. Before being placed in the mouth the rims should be carved buccolingually to the width of the natural teeth, so that they will feel as natural as possible to the patient.

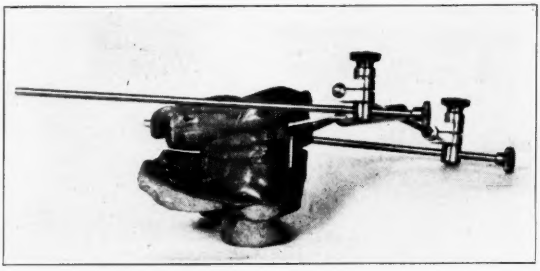


Fig. 19.—Baseplate with transfer bow, equalizing wax and centering pin attached.

This type of occlusal rim distributes equally the applied force in all ranges,

lateral, protruded or retruded; and in securing the relation of the mandible to the maxilla, the trial dentures maintain perfect adaptation to the mouth. It will be noted, if flat occlusal rims are used, that when the mandible is protruded, the condyle glides forward on the eminentia articularis and the incisal edge of the occlusal rims are in contact. The distal or molar regions are separated; whereas, occlusal rims that conform to the surface of a sphere allow the patient full range of occlusion, maintaining the rims in contact and always balanced.

Adjustment of Occlusal Rims in the Mouth to Establish Correct Jaw Relationship.—Thus far, the laboratory technic has produced upper and lower baseplates with the occlusal rims so arced and formed that, when they are placed together, there is maximum contact of the occlusal surfaces. It then becomes necessary to observe the extent of this occlusal contact when the baseplates are correctly seated in the mouth. The baseplates are seated in the same manner that the impressions were taken. The patient is instructed to close, and the discrepancies in the occlusal contact are noted by marking the areas of contact. The object at this time is to produce a maximum contact in centric occlusion, in forward occlusion, and in right and left lateral occlusion, maintaining a jaw relationship that does not permit condyle encroachment. (Fig. 12.) To accomplish this, before any adjustment of the wax is attempted, the operator places the little fingers in the patient's ears, and with the thumbs on the forehead, pressure is exerted forward on the anterior wall of the external auditory meatus as the patient opens and closes. In an incorrect jaw relationship or closed bite condition, the condyle impinges on the external auditory meatus; and when the mandible passes the normal position in closing, a definite backward thrust of the condyle is felt on the balls of the little fingers. The occlusal rims should be high enough to stop the closing of the mandible before the condyles get back to this point of encroachment. When opening and closing in centric relation, only a slight rolling motion of the condyles should be felt by the little fingers. The backward thrust should be eliminated.

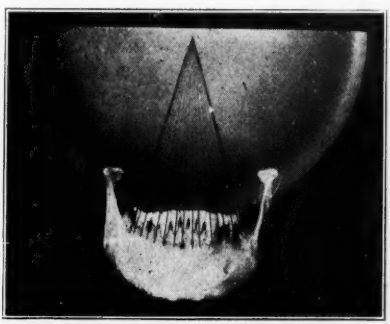


Fig. 20.—Sphere applied to mandible with lines of force indicated.

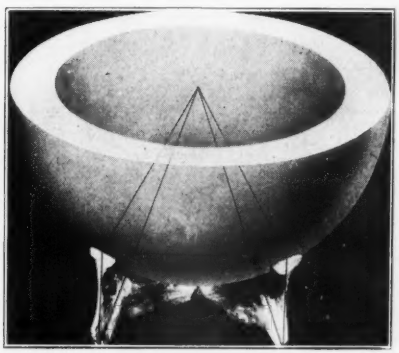


Fig. 21.—Relation of condyle centers to the sphere.

Many times, it is necessary to compromise on the height of the occlusal rims where the lost dimension is considerable, as the muscle strain would be too severe. The best way to bring these cases back to normal relationship is to step them up with more than one set of dentures.

CENTRIC RELATION

There are almost as many methods of determining the centric relation, or rest position of the mandible to the maxilla, as there are individuals practicing prosthetic dentistry. In theory, recording the gothic arch seems to present a solution.

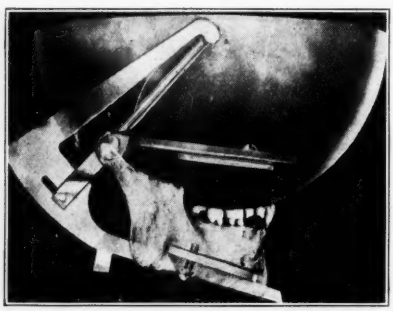


Fig. 22.—Relation of sphere and instrument to the occlusion and condyle.

In practice, this does not prove true, because of the instability of the baseplates. Attempting to record the gothic arch in one occlusal rim, by the use of pins protruding from the opposing rim, is apt to cause shifting of the baseplates, so that the record is seldom accurate. By the use of the pencil and card attached to the occlusal rims, or the extraoral method of recording the gothic arch, some of the shifting of the baseplates is overcome. This procedure has the disadvantage of having so much paraphernalia attached to the plates that the patient is overly conscious of it, and the movements of the mandible are unnatural and usually forward of the normal masticating range.

Experience seems to indicate that, to obtain the normal rest position of the mandible in all cases, conditions must be as nearly normal as possible, and the patient must not be conscious of what is being done. The baseplates must be accurately fitted and the occlusal rims must be the shape and form of the natural teeth and must be in the mouth long enough for the patient to overcome

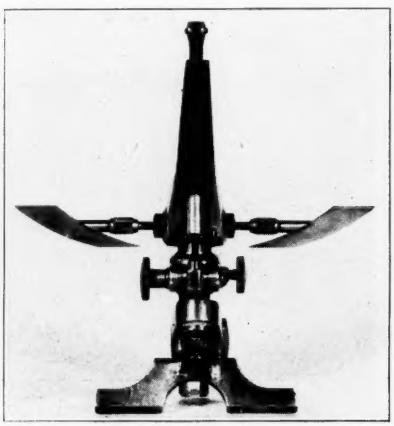


Fig. 23.—Compensating curves.

the initial awkward and strained condition. When this has been accomplished and the rims are balanced so that there is a maximum occlusal contact in all ranges, the patient is engaged in conversation, when the mandible will travel forward from the rest position and return to this position. By keen obsevation, the operator can determine the rest position and mark it on the upper occlusal rim by drawing a line on the occlusal surface of this rim, indicating the position of the lower rim in contact. This

marking should be further checked by having the patient open and close several times, without restraint. The overjet of the upper rim should be of an amount to allow the labial surface of the lower rim to come into line with it, in the forward excursions of the mandible, as in conversation. This indicates the amount of overjet required in the setting of the teeth.

When the position of centric relation is definitely located, the rims are removed from the mouth and placed in occlusion in this position, shown in Figure 13. A short pin (14 gage) is attached to the labial surface of the lower rim, fitting into a hole in the occlusal surface of the upper rim.

The baseplates and rims are then replaced in the mouth and the position of the high lip line and corner of the mouth is marked on the upper rim. The high lip line is a guide in the selection of teeth and the corner of the mouth indicates the location of the distal surface of the upper cuspid. The median line is also marked at this time on both occlusal rims. The line of contact between the upper and lower occlusions should be on a level with the line of the lips when in contact. The labial surface of the wax rims should be contoured to the position of the anterior teeth.

Transfer of Occlusal Rims in Centric Relation from Mouth to Instrument.—(Fig. 14.) The object of this step in the procedure is to locate and register the distance from the center of the condyles to the occlusion, so that we may establish a like relationship between the occlusion and the axis of movement on the instrument.

Fig. 24.—Projection showing the relation of the compensating arc to the condyle and condyle marking.

First, the position of the condyles is established on the patient by having the patient open and close the mandible several times and by placing the index finger in the depression on the side of the face caused by the opening and closing movement. (Fig. 15.) The heads of the condyles can be distinctly felt. A

mark is placed with a soft lead pencil on the tissue where the head of the condyle is located in centric relation. If the heads of the condyles cannot be felt, a mark one-half inch forward of the center of the tragus of the ear is placed on a line with the angle of the nose. (Fig. 16.) This mark then serves as the condyle location.

The transfer plate has been modified so that it can be inserted in the labial surface of the upper occlusal rim instead of being attached to the occlusal surface. This change has been made so that equalizing wax is used on each side between the occluding surfaces of the rims.

After the transfer plate is attached to the upper occlusal rim, two pieces of softened beeswax are placed on the occlusal surface of this rim, one on each side over the position of the second bicuspid and first molar, and about the size of these two teeth. Both trial dentures are quickly put in the mouth and the patient, with the aid of a hand mirror, is asked to close in such a way that the metal pin previously attached to the lower rim will enter the socket on the

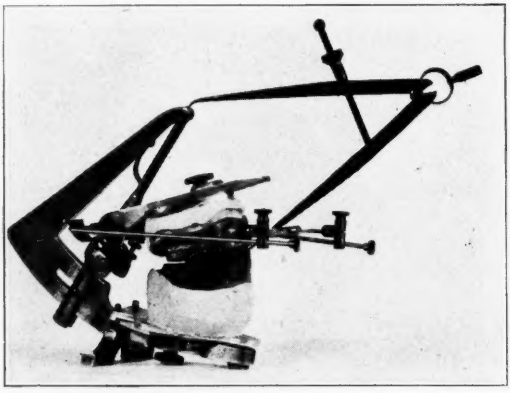


Fig. 25.—Case mounted on the instrument with dividers and transfer bow.

centric relation can be reestablished when the transfer plate and bow are in position.

EQUALIZING THE BITE

It is an established fact that it is impossible to carve hard occlusal rims of either wax or compound so that, when in occlusion, there is equal pressure on both sides. Therefore, it is necessary that we have some method of seating each baseplate accurately, and at the same time register the relation between the two. (Fig. 17.) To accomplish this, an upper rim, thereby establishing centric relation. Do not allow the patient to close completely so that the two rims are in contact. If the rims come in contact at this time, the effect of the equalizing wax will be nullified, owing to the fact that the occlusal contact may be heavier on one side than the other and cause the dentures to tip until the pressure is equal. The patient should be allowed to close into the softened beeswax until there is a space of about 2 mm. between the occlusal surfaces of the rims.

While the patient maintains this position, the soft beeswax is molded over the buccal surfaces of both upper and lower rims so as to hold them together. (Fig. 18.) The transfer bows are then attached to the transfer plate and the ends adjusted to the condyle markings on the side of the face, and locked in position. (Fig. 19.) Upper and lower trial dentures are now removed from the mouth at the same time, as they are fastened together and attached to the transfer bow. Care should be taken not to disturb this relationship in mounting the case on the instrument.

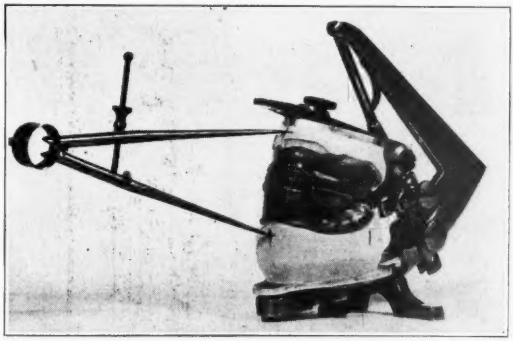


Fig. 26.—Recording the space between the casts.

MOUNTING THE CASE ON THE MONSON INSTRUMENT

In the use of the Monson instrument, it is necessary that there be some understanding of the principle on which this instrument is constructed. (Fig. 20.) The spherical theory of occlusion as evolved by George S. Monson establishes the premise that the occlusal surfaces of the mandibular teeth as well as the centers of the condyles, in the higher type of natural development, conform to the surface of a sphere. Also, the long axes of the teeth are directed toward the center of the sphere and the movements of the mandible follow this spherical surface. (Fig. 21.) The diameter of this sphere, in the average case, is about 8 inches, and the radius, 4 inches. Variations from this average are very slight, and of little consequence, because the difference in the degree of curvature within the mandibular range, and with a variation of as much as 1 inch in the diameter of the sphere, are not detectable, even with casts of the natural teeth.

The Monson instrument is constructed to conform to this spherical principle; and to make possible the restoration of occlusions to the natural form. (Fig. 22.) The point at the top of the instrument, called the center, represents the center of the sphere of occlusion, and is the point around which all movements rotate. In the transfer of a cast to the instrument, it is necessary that the same relation between the occlusion and the hinge axis of the instrument be established as prevailed between the occlusion and the condyles in the mouth.

The occlusal rims with the transfer bow attached, as removed from the pa-

tient's mouth, are taken to the laboratory and the casts inserted in their respective baseplates. All control screws on the instrument are locked and the radial arm is set in the forward end of the slot in which it travels. (Fig. 23.) The compensating curves, which have displaced the straight condyle rods formerly used, are set in the hinge axis hub, and adjusted so that the arcs, on the upper surface, are 4 inches from the center over their entire length, as measured with dividers. The plates carrying these

Fig. 27.—Profile guide.

arcs should be parallel with the radial arm.

The compensating arcs are used in place of the straight condyle cords, because it has been found that it is possible to make a more accurate transfer of the condyle relation by their use. (Fig. 24.) In children and underdeveloped adults, the condyles, while maintaining a position on the surface of the sphere, are closer together and therefore lower down on that sphere; while, in the use of the straight cord, all widths of mandibles were mounted to the same height in the condyle region. To correct this error, A. G. Bjorkland designed these devices carrying two curves, the upper one representing the surface of the 8 inch sphere, as it passes through the condyles, and the lower representing the curve described by a series of horizontal projections three quarters inch out from the arc, passing through the condyles. This projection of three quarters inch

Fig. 28.—Measurement of facial dimension.

represents the average thickness of tissue between the condyle and the point of location on the skin of the face.

The casts, fitted into their respective baseplates, are placed on the instrument and the three jack screws under the lower cast adjusted so that the ends of the transfer bows make contact with the compensating curves, equidistant from the ends of the curves; and the incisal

edge of the lower occlusal rim in the median line is 4 inches from the center at the top of the instrument. (Fig. 25.) Both upper and lower casts are attached to the instrument in this position.

As soon as the plaster has set, the transfer bows and plate are removed and the spacing screw is adjusted, back of the upper cast, so that it will keep the upper cast from closing down when the occlusal rims are removed. (Fig. 26.) The distance between the two casts is recorded by scratching a mark across the median line of each cast with a pair of straight dividers. A record of this distance is made on the side of the lower cast so that it can be reestablished should the dividers become changed.

Fig. 29.—Extracted teeth in an impression made before extraction.

At this point, the transfer of the case to the instrument is complete, and we are ready for the arranging of the teeth.

ART AND ESTHETICS

The esthetic phase of full denture construction seems to have such a different meaning to so many dentists that it might be well to describe just what it consists of before taking up a discussion of the subject. It is our experience that, when the term "esthetic" is mentioned, it may mean tooth arrangement to one man, and tooth color to another, while to another it merely means harmony; and our ideas of harmony of form and color differ as widely as our ideas of beauty.

Esthetics as applied to dentures means the restoration of the patient to a normal condition of appearance as far as the loss or abrasion of the natural teeth has altered that appearance. It covers the entire technic of denture construction, with the exception of the impression. Tooth form, size and color, length of the bite, tooth arrangement, arch form, plate form, occlusion and grinding in all have an influence on the esthetic result of this work.

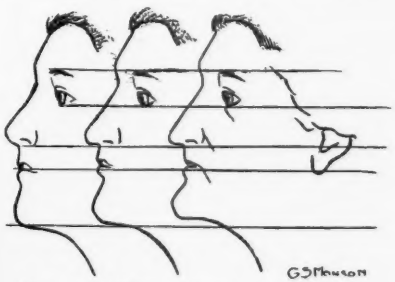


Fig. 30.—Three stages of restoration.

The chief interest and in many cases the only interest, on the part of the patient, in the results of this work, is in the appearance. When a patient is advised that his teeth must be lost, either wholly or in part, his greatest concern is the change that it is going to make

in his facial expression. He immediately calls to mind some friend whose appearance has been so changed by the use of artificial dentures that the results are wholly unnatural and displeasing. This state of mind sets up an antagonism to the work which, from the very outset, is a handicap to both the patient and the dentist.

Patients who are confident that the result will be pleasing to the eye are eager to lend their cooperation over the period of adjustment, and when the time comes that we can assure our patients that **they** need not lose their natural appearance through the loss of their teeth, that group of patients now classed as mentally unfavorable will be almost nil. When we observe the many horrible examples of our "art," it is little wonder that so many people are antagonistic and critical toward this service. When we have discharged a patient for whom we have not rendered the best possible service from an esthetic standpoint, we can be sure that we have created at least ten potential mentally unfavorable cases among the patient's family and friends.

Fig. 31.—Patient before and immediately after restoration and three weeks later. A strained appearance is evident immediately after the opening of the bite, but improvement in three weeks is notable.

An attempt will be made to present briefly some definite guides in obtaining an esthetic result in denture cases. As was previously stated, a harmonious result is not necessarily an esthetic result from the patient's point of view, because our conception, and the patient's conception of harmony may be quite different. Therefore, if we hope to bring our idea of harmony to the patients' view, we must have all the definite guides possible to restore them to their own natural appearance and expression.

In most cases, when we see the patient before the extraction of the natural teeth, a number of valuable guides can be obtained which will aid us in reproducing the individual characteristics of that patient. (Fig. 27.) The first guide is the profile guide, which is of value only when there has been no appreciable closure of the bite through the loss or abrasion of the posterior teeth; that is, when the dimension from the angle of the nose to the tip of the chin has remained constant. This guide, which was first described by Robert R. Gillis is obtained by bending a strip of lead plate about one quarter inch wide to fit the contour of the face in the median line from the line of the hair to the junction of the chin and neck. The contour of the lead strip is then cut from card-

Fig. 32.—Square, tapering and ovoid forms.

board, and the cardboard used as a mold in maintaining the profile.

In those cases in which the normal facial dimension has become lost, through closure of the bite, the measurement from the angle of the nose to the tip of the chin should be taken for comparison after the bite is opened with dentures. This furnishes an additional check in opening the bite. (Fig. 28.)

At this time, our most definite and valuable guide can be obtained. (Fig. 29.) A good impression of the natural

Fig. 33.—Transfer bow as a leveling device.

teeth should be taken and the teeth placed in their respective positions in the impression after extraction. Plaster is then poured into this impression, a model of the mouth being made with the natural teeth in their exact relation to each other. This is better than the usual plaster model because there is no distortion through dragging of the impression, and each tooth is clearly defined. These models can be used in obtaining correct tooth form, arch form, overbite and overjet, tooth arrangement and inclination; also, to show the patients, in case they get some perverted idea as to what their own teeth were like. With models such as these before the operator, it is possible to reproduce all the irregularities of the natural teeth in making the dentures. It is also possible to tone down or soften startling irregularities without losing their effect or producing any apparent change. With the models as a guide, patients may sometimes be given a more pleasing appearance with artificial dentures than with

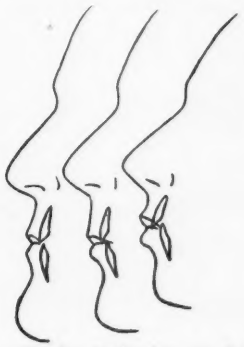


Fig. 34.—Profile indicating the labial inclination of the incisor teeth.

their own teeth.

In those cases with no natural teeth to aid in obtaining an esthetic result, we must be guided by other landmarks and contours of the jaws and face. (Fig. 30.) We may use the face form as a guide to the tooth form, but we must first restore the normal face form. The length of the lower part of the face has been reduced and must be brought back to as nearly normal as possible, before the contour of the face is used as a guide in the selection of the size or type of tooth. The tooth selection should

be made after the bite is restored and with the baseplates and occlusal rims in the mouth.

In establishing the proper facial dimension or length of bite, we not only determine the relation of the mandible to the maxillae, but, in so doing, establish the length of the face as well. This step might be compared to the artist's preliminary sketch in painting a portrait, as it produces the general outline form in which the detail is placed. The artist first sketches his outline to get the correct proportions and then places the details, such as the eyes, nose, mouth and

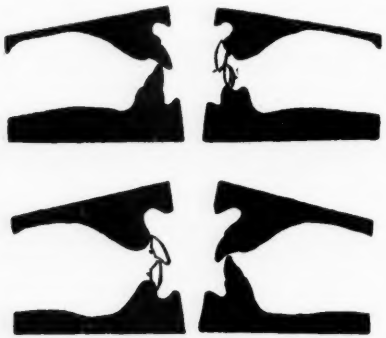


Fig. 35.—Silhouette of case before and after extraction with correct and incorrect inclination of incisors indicated.

lips; and so we must first establish the correct general outline form and dimensions before giving consideration to the detail of tooth form and arrangement.

The relation of the mandible to the maxillae controls, to a great extent, the relation of all structures attached to the mandible, and, for that reason, has an influence on the tone of the integument and muscles of the face and jaws. (Fig. 31.) For many years, the guide in establishing the jaw relationship has been the lip line and contour. The lip is a soft, transient tissue that accommodates itself to the supporting structures, and is not sufficiently constant in its position to be used as a guide. Also, the position of the lip line is altered by either opening or closing the bite, and if it has remained in a false relationship, does not return to normal until several weeks after the bite is restored. Immediately after the bite is opened, the lips have a stretched and strained expression, and if we used the lip only as our guide, we would maintain the bite in the ugly closed relation. In a case which presents a closed condition, it is just as ridiculous for the dentist to use the lip as a guide

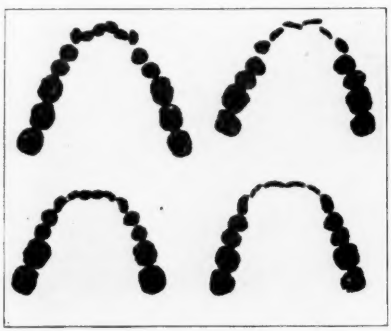


Fig. 36.—Silhouette of occlusal surface, square and tapering type.

to the length of the teeth and bite as it would be for an engineer to attempt to restore a broken down archway from the position of the awning attached to it. The relation and length of the lips are dependent on the position of the osseous structure, and not vice versa.

The best guide that we have thus far been able to obtain in establishing the length of the bite, where no measurement of the normal conditions are obtainable, is the condyle test. This in many cases can be supplemented by a photograph, which was taken before the loss or abrasion of the natural teeth.

J. Leon Williams has evolved a basis of classification in the three typal forms of face, from which he has built up a system of tooth molds to harmonize with the face form. (Fig. 32.) We find, of course, that in the natural teeth there are, owing to interference in development, many cases in which this harmony does not exist. Nevertheless, his classification is a valuable aid in the esthetic phase of our procedure and should be familiar to all prosthodontists. The three basic or typal forms are the square, tapering and ovoid, each having the general characteristics indicated by their name.

Fig. 37.—Casts and baseplates mounted in centric occlusion.

The square face has almost parallel sides; but the face may vary in length in comparison to width. It is characterized by the full well-developed chin and broad forehead, with little or no depression in the temporal regions. The forehead is distinctly flattened in the center or region of the glabella and has definite angles at the sides. The tapering type, as the term indicates, has converging sides and tapers both ways from the zygoma. The lower two-thirds tapers to a small chin; and the upper third, to the comparatively narrower forehead. This appearance of lack of width in the forehead is due to a marked depression on each side in the temporal regions. This is the angular type, and we find definite angles at each side of the forehead and at the angles of the jaw. As in the square type, there is a flattened area in the region of the glabella.

The ovoid face has diverging lines from the zygoma to the angles of the jaw, which gives the face the greatest width at the angle. Unlike the tapering and square types, this type is entirely without angularity. The outline is a series of well-rounded curves. The chin is small, with a depression on either side. The forehead is also small, with a marked depression in the temporal region. There is no flattened area in the region of the glabella nor are there angles at the side, the forehead being one continuous curve from temple to temple. Many times, square and tapering types are confused with this type because of

Fig. 38.—Setting the lower anterior teeth.

an excess of adipose tissue in the cheeks. For that reason, the shape of the forehead and chin should be particularly noted.

Tooth color has some bearing on the esthetic result in our denture cases, but seems to be so much better understood that we do not see the number of flagrant errors that are seen in tooth form and arrangement. It seems to be quite commonly accepted among prosthetic teachers that the number of hues required for this branch of dentistry is limited. Certainly not all those furnished by the manufacturers are necessary. It is good practice to use a gradation of shades in the same case in many instances. Few of our patients reach the edentulous stage and have all the remaining teeth the same shade, at the time of extraction. This same breaking up of the sets is very effective in the molds also. This is especially true in using the square molds in feminine faces. The central incisors of this particular group are very good, but the lateral incisors and cuspids are little more than square blocks of porcelain with no character. The wide lateral incisors as furnished with the square molds are distinctly masculine in character and should never be used in the true feminine faces. The cuspids in most of the square molds are too short.

So much for tooth form and color, which may be considered the least important of all the steps which have an influence on the esthetic result in full denture service. It might be well at this time to enumerate, in the order of their importance, those features of the full denture technic which have a bearing on the esthetic result: 1. Facial dimension (length of the bite). 2. Arch form. 3. Plate form. 4. Tooth arrangement (inclination and irregularities). 5. Tooth form and color.

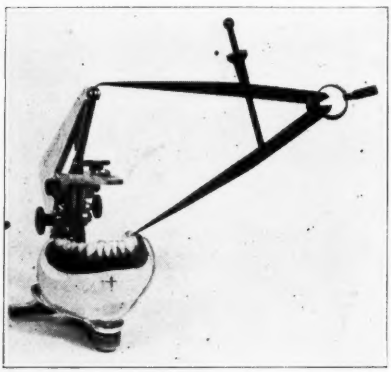


Fig. 39.—Full lower set up to dividers.

Fig. 40.—First molars and cuspids for correct intercusping.

In taking the bite and transferring the case, there are several other guides of esthetic value which should be obtained. The occlusal rims should be carved to the amount of overjet required for the case, so that the teeth may be set up correctly in the relation of the upper to the lower. The arch form of the occlusal rims should also be noted so that a correct arch form may be obtained in the first set up.

When a transfer bow is used to mount the case on the instrument and the teeth are set up to a common radius from a common center, no leveling device is necessary to parallel the occlusion to the pupils of the eyes or other landmarks. (Fig. 33.) This is accomplished with the transfer bow in locating the condyles, and if the case is properly mounted, there will never be any discrepancy in the height of the occlusion on one side in relation to the other side.

In setting up the teeth, we have both the occlusion and esthetics to consider,

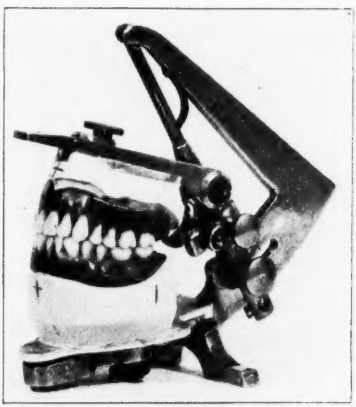


Fig. 41.—Full set up.

and it is in this step of our procedure that we obtain the detail of the picture. Previous to this, we have been obtaining the general outline form, but now we have the opportunity of placing all those little details of arrangement which are to make the picture complete, giving those individual characteristic touches which will distinguish each case from all of the rest. From the esthetic point of view, this phase of the work might be called tooth arrangement. It depends for its success chiefly on the inclination and irregularities given the teeth. (Fig. 34.) In nearly all cases, both the upper and lower natural incisors have a decided labial inclination. Rarely do we find the labial surface of the incisors inclined lingually or even on a vertical plane. An idea as to the degree of inclination can be obtained from the profile of the face. The upper incisors will be found to correspond closely to the inclination of the upper two thirds of the face and the lower incisors to the lower third. In constructing dentures, one of the most common errors is a vertical position of the incisors. (Fig. 35.) We have here illustrated silhouettes of a case before and immediately after extraction, the dotted drawing in-

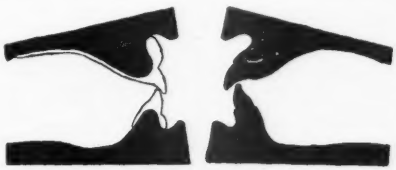


Fig. 42.—A common error in plate form as compared with the form of the natural gums.

dicating this common error as compared with the correct position; also the same case after absorption has taken place with the correct inclination of the incisors illustrated. In this arrangement of the teeth, models containing the natural teeth in their relationship before extraction are most valuable. These models enable us not only to produce the correct inclination and arch form but also to reproduce the irregularities of the case.

Few cases of natural dentures have perfect alinement of the anterior teeth. (Fig. 36.) This is especially true of the lower incisors, and for this reason it is seldom advisable to construct dentures

without tipping or staggering these teeth to a greater or lesser extent. As a rule, the small or narrow arch has the more exaggerated irregularity. The large square arch, being the high type of development, contains less irregularity. Crowding of the teeth is particularly characteristic of the tapering type because, in a large majority of cases, lack of development has given these individuals the tapering form.

There is no one step or any full denture technic which controls the esthetic result. At all stages in the process of denture construction, we are producing something which will have an influence on the appearance of the patient, and we should look on the problem of esthetics as a part of the whole procedure rather than a separate and distinct step. The popular conception has been that tooth arrangement entirely controls the esthetic phase of this branch of dentistry. In fact, many dentists limit the consideration of esthetics to the upper six anterior teeth; with the result that the patient has little appreciation of the value of the service rendered. It should be remembered that the patient's conception of the value of a denture is based almost wholly on his appearance when wearing that denture.

SETTING UP OF TEETH

With the case mounted on the instrument, and the dimension between the casts recorded, the next step is the setting of the teeth in position on the baseplates. (Fig. 37.) It will be remembered that, when the patient closes into the equalizing wax in taking the bite, a space of about 2 mm. is maintained between the occlusal rims. This additional dimension is preserved in setting up the teeth, to allow for the grinding in and setting of the dentures. This is accomplished by dividing the amount between the upper and the lower, approximately 1 mm. on each, the 4 inch setting of the dividers being shortened 1 mm.

The lower teeth are set up first. (Fig. 38.) The lower occlusal rim is entirely removed from the baseplate, and the upper baseplate, with the occlusal rim attached, is waxed to the cast. The lower six anterior teeth are set with the incisal edge to the spacing of the dividers from the center on the instrument. The arch form and labial position is determined by the marking on the upper occlusal rim, indicating the amount of overjet established in the mouth. The gingival end of these teeth should be on a line slightly labial to the crest of the ridge. The position of the cuspid should be such as to allow the upper cuspid to be set in the position indicated by the markings made in the mouth. (Fig. 39.) The lower posterior teeth are set as closely as possible over the center of the ridge, and with both lingual and buccal

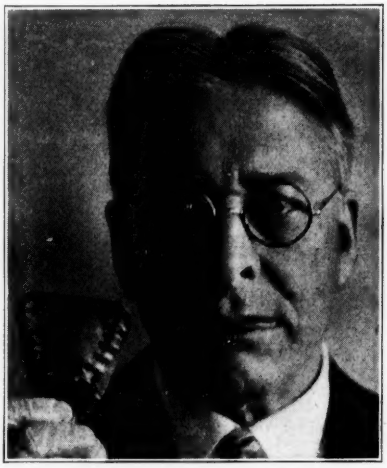


Fig. 43.—Checkbite for remounting.

cusps equidistant, according to the dividers, from the center on the instrument. This method fixes the occlusion of these teeth so that they conform to the surface of a sphere having a diameter of about 8 inches.

In the setting of the upper teeth, all of the occlusal rim wax is removed and each tooth is set in a separate section of softened wax, as in the lower denture. The upper first molars are set in their proper position of occlusion first, because these teeth are the largest in the arch and will act as a guide in establishing the correct intercusping of the balance of the posterior teeth. The cuspids are set next because they are the guiding teeth in the lateral range and should properly intercuspate, to prevent extensive mutilation in the grinding in. (Fig. 41.) The balance of the upper teeth are placed, being spaced or crowded, according to the esthetics and occlusion of the case.

After the teeth are all set up, the control screws on the instrument should be unlocked and the occlusion tested for maximum contact and balance in all ranges of mastication. It might be well to state here that the lateral range is not reproduced on this instrument by a straight side to side movement but is best obtained by exerting pressure on the labial surface of the upper cuspid, in the direction of the first molar on the opposite side.

PLATE FORM

After the occlusion is adjusted to a satisfactory balance, the case is waxed to the form required for the finished denture and is ready for the final study and checking in the mouth before finishing. In establishing the form and contour of the labial and buccal flanges of the wax plate, we should follow the form of the natural gum as closely as possible. There should be an eminence in the cuspid region and the median line with a marked depression in the region of the lateral incisor and bicuspids. (Fig. 42.) The pink gum of the denture should, in no case, be more prominent

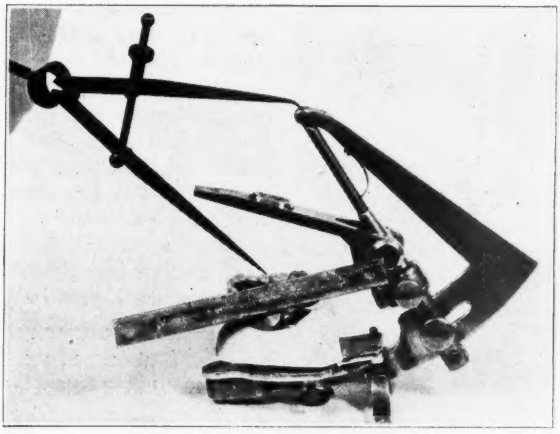


Fig. 44.—Remounting to the radius and altitude.

than the labial surfaces of the incisor teeth, as this condition does not exist in the natural gum contour. When such a condition occurs in the wax denture, it is an indication that the upper teeth are set too far back, and they should be reset, being given greater labial inclination and overjet.

TRYING IN THE DENTURE

There are several things to be carefully studied in the checking of the case in the mouth at this point. 1. The occlusion, and particularly centric occlusion. Care should be taken to make sure that this is correct. 2. Esthetics. Under this heading, the entire appearance of the case should be noted. The length of the bite should again be checked with the condyle test, or the profile guide if available. The arch form, tooth form and color, tooth inclination and irregularities should be noted. The form of the wax producing the proper curvature to the lips should be observed.

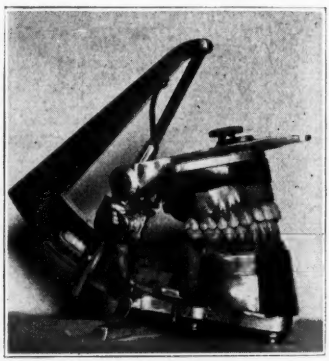


Fig. 45.—Case remounted for grinding and milling.

To obtain all this information satisfactorily, it is necessary that the dentures be in the mouth long enough for the patient to lose the initial strangeness. For this reason, the teeth should be mounted in hard wax and sealed to that wax with a sticky wax. When the patient is able to converse freely, the forward excursions of the mandible should be noted. The overjet should be sufficient to allow the lower incisors to come forward to the position of the upper incisors in conversation.

If for any reason it is found advisable to open or close the bite at this stage, it may be done on the instrument, without remounting the casts. The spacing screw is adjusted so as to raise or lower the upper cast the desired amount. The teeth can then be reset to the corrected position. The same is true of the centric relation. If in the trying in, it is found that the position of centric occlusion does not conform to centric relation of the jaws, a checkbite is taken in the correct relation and the instrument locked in the new position for resetting the teeth. Usually, it is necessary to reset the upper teeth only. After all corrections are made, the case is ready for finishing and polishing.

FINAL ADJUSTMENT OF THE OCCLUSION

The finished dentures are inserted in the mouth and the patient is instructed to close and swallow several times, the object being to seat the dentures. At this time, any apparent high spots or obstructions in the occlusion are removed with a small carborundum stone. The patient is then dismissed and allowed to wear the dentures for several days; this interval being sufficient to allow the dentures to become firmly seated before the grinding in.

When the patient returns after wearing the dentures several days, be sure the dentures are seated properly. (Fig. 43.) Heat a piece of checkbite wax in a water bath at about 120 F., so that it

is of an even temperature throughout its thickness. Take a full occlusion checkbite with the mandible in the most retrusive position, being careful not to let the patient bite clear through the wax. This is important because, if the cusps touch, the mandible may be guided to a wrong position or the dentures shifted on their seat. The checkbite acts the same in seating the dentures as the equalizing wax in taking the balanced bite.

For the final grinding in, the lower denture is remounted on the instrument in the same position in which the teeth were set up. This is accomplished by the use of the transfer bow technic, or by using the same radius from the center and altitude from the hinge axis as those of the occlusion when the teeth were set up in wax. The under cuts of both dentures are filled in with soft beeswax to facilitate their removal from the plaster, and a plaster base is made for the lower. The radial arm is locked in its most forward position and the centering screw for the cast carrying arm is tightened so that there will be no movement. Let us assume that the altitude to which the teeth were set was 3½ inches and the radius 4 inches. (Fig. 44.) When the plaster has hardened, the base is placed with the denture on the instrument at a 3½ inch altitude. Then with the dividers at 4 inches, the bent point is placed in the center at the top of the instrument and the other point at the mesio-incisal edge of the central incisors. The cast is adjusted so that the surfaces of all the teeth conform to this radius, just as was the case when the teeth were set up in wax. When correct, it is fastened to the lower cast carrying plate with plaster. When the plaster has set, the centric occlusion checkbite is placed on the lower denture, and the upper denture on the checkbite, the operator making sure the teeth fit in their proper places, and the denture is secured to the upper cast carrying arm. (Fig. 45.) The plaster having set, the checkbite wax is removed, and it will be observed that what appeared to be a good occlusion in the mouth is not so good on the instrument, the reason being that the dentures move on the soft tissues, thus adapting themselves to the condition of malocclusion, while the instrument is perfectly rigid.

With a piece of carbon paper about 3 inches square, the spots on the dentures that strike first are located, and with a one-half inch medium grit carborundum stone in the engine, are ground until all teeth are in contact in centric occlusion. Do not grind so as to destroy the anatomic form of the cusps. The control screw is loosened on the radial arm, and again with the carbon paper the case is ground into the forward range; that is, the range in which the labial surfaces of the anterior teeth are continuous and the posterior teeth are in contact, all barriers that will prevent the teeth from going as far as the excising bite, which is the limit of the forward range, being thus eliminated. If these barriers are not removed, the dentures will be either unseated or locked in a position which limits the forward movement of the mandible.

To grind in the lateral range, all control screws are loosened. Bear in mind that the lateral range is not at right angles to the forward range but between the two, that is, forward and lateral, the cuspids being the guides. To obtain the lateral range, the thumb is placed on the labial surface of the upper cuspid, pressure being exerted toward the first molar on the opposite side, driving the upper cuspid between the lower cuspid and the first bicuspid. The occlu-

sion has now been roughly approximated with the carborundum stone as indicated by the carbon paper. We now polish off all minute obstructions which will prevent the mandible from gliding back to its full retrusive position from any point that it may have taken within the range of occlusion. For this purpose, an abrasive paste is used between the surfaces of the teeth. First, we polish the forward range by moving the upper denture on the lower, then the lateral ranges. This polishing takes but a short time and is completed when the surfaces of the teeth pass over each other without obstruction. A regrind on the instrument may be necessary from time to time to correct the occlusion which becomes faulty owing to tissue changes and uneven absorption, in cases of recent extraction.

CONCLUSIONS

The common causes of failure in full denture construction may be classified in six divisions:

1. *Faulty Impressions.*—It is possible, with any impression material, to produce a faulty impression, by overlooking some essential point in the technic of handling that material. For this reason, there is a distinct advantage in using a material which makes it possible to determine the accuracy of adaptation of the finished impression before proceeding with the construction of the denture. This requirement eliminates plaster of Paris, and while such a statement may seem radical to those who are successfully using plaster, there is a great degree of satisfaction to the operator in knowing that the impression is correct before proceeding further. Little difficulty is experienced in the use of modeling compound if the fundamental rule, namely, a definite and uniform thickness of material in the finished impression, and maintenance of pressure in a predetermined straight line, without shifting of direction, is observed.

2. *Baseplates.*—The baseplates must be accurately fitted and of a material capable of withstanding mouth temperature and occlusal stress without changing form. Centric relation cannot be definitely determined with soft or poorly fitted baseplates. Faulty centric relation is one of the most common causes of failure in full dentures.

3. *Occlusal Rims.*—The flat plane of occlusion in the arrangement of teeth was discarded some years ago, because it was not in harmony with the movements of the mandible, but the flat plane in bite-blocks is still quite generally used. This inconsistency is responsible for many errors in occlusion and centric relation. Also, flat occlusal rims will cause the baseplates to pull away from the lingual side of the lower ridge and the palate.

4. *Centric Relation.*—Not only is faulty location of centric relation a common error; unequal pressure in centric occlusion is more so. Hard wax cannot be carved to the degree of accuracy required to produce equalized pressure on both sides or even over the entire area on one side only. Unequal pressure in occlusion is more often the cause of trauma and instability than any other factor in full denture technic. When the molars are too high, in the finished denture, the laboratory technician is usually accused of not closing the flask before vulcanizing. Those operators who are using an equalizing wax in establishing centric relation do not have such experience; which indicates that the fault is due to error on the part of the operator rather than the technician.

5. *Tooth Arrangement.*—Unless the teeth are arranged to simulate the natural teeth and produce a pleasing and

harmonious result from the esthetic point of view, the patient is disposed to lack confidence in the restoration, and becomes discouraged during the period of adjustment. This attitude influences the patient to the extent that the fit of the dentures is questioned and trouble results.

6. *Balanced Occlusion.*—This phase of full denture technic has been the subject of so much discussion in the past ten years that there has been a vast improvement. However, a word of warning concerning grinding and milling might be in order at this time. Grinding and milling are necessary to correct the slight discrepancies in the porcelain teeth and the changes that take place from the time the case is waxed up until it is finished. Care should be exercised to avoid extensive milling. If the teeth are ground to the extent that the opposing cusps fill the sulci and grooves, the supporting tissues will not withstand the degree of force required in mastication. Artificial teeth should be ground to sharp shearing angles rather than flat planes. Victor H. Sears has embodied this idea in the channel teeth, and while these teeth have not been in general use long enough to judge them on a clinical basis, the idea is logical, and it only remains to decide how far it is practical to depart from the natural tooth form in the application of this idea.

The Monson technic, like any technic which is successful, is exacting and definite. This technic, which affords a method of checking the results of each step before proceeding with the next one, is designed to produce results in the hands of the man of average skill and ability. If the detail of the technic is mastered, there is no reason why any dentist should not experience a large degree of satisfaction in denture service.

DISCUSSION

O. M. Dressen, Milwaukee, Wis.: A paper of the type presented by Dr. Keyworth is much too long for presentation in its entirety at a meeting of this kind. The time is too short to go into the various details of technic. They would not be retained by anyone present, and could better be presented through the literature and read at one's leisure. In the matter of the impression technic, it seems that greater attention to detail would give a better and more accurate impression. The buccal and labial periphery of the upper impression causes distension of the border tissue attachments, and an impression is taken of this area that is not correct. The same is true of the lower impression excepting that a lower impression needs more accuracy, care and attention to detail in regard to impinging of tissues than does an upper. The impressions could be further improved by the use of a tracing stick and by perfecting the periphery and any other areas needing correction. A valve seal on the cast is not necessary. It usually causes undue pressure and a resulting resorption of the underlying tissues. It is more accurate to postdam the impression than to valve-seal the cast at the posterior denture border. The centric relation of the mandible to the maxilla is most important. Dentures constructed that are not in the correct centric relation of the mandible to the maxilla will not properly function, and the shunting of the dentures, with the resulting movement on their bases, will cause the underlying tissues to resorb and the mouth to become soft and flabby. The use of the two small pieces of softened beeswax between the occlusal rims will equalize pressure on the bases, but in closing, the patient will invariably slide the jaw forward and give a false centric relation. Fastening the two rims together and removing them from the mouth as one will usually cause the relation to be distorted before the case is mounted. The transfer bow, or face-bow, is useful but not essential to correct mounting of the casts on an articulator. To locate accurately the head of the condyle in relation to the mesio-incisal angle is as much of a guess as to mount the cases to an average position on the instrument. With the new compensating condyle cords, there is still the varying thickness of tissue in different individuals to contend with. It is an external measure-

ment to locate the Bonwill triangle. Speaking of a 4-inch radius: Is it 4 inches in all cases or does it vary in different individuals? The anterior teeth govern esthetics, the upper six or eight anterior teeth more so than the lower. It would therefore seem more practical to arrange the six upper anterior teeth before any lower teeth are set, or until their position is pleasing to the eye. Marks placed on the occlusal rims are usually of no great advantage because they are lost before the teeth are placed. The bite or interdental space cannot be opened or closed on any articulator without changing the relation of the casts. It is a chair, and not a laboratory, operation. A new bite must be taken and the upper cast remounted, because the opening axis on any articulator is not the same as that of the patient. Cases should be accurately checked for occlusal balance on insertion and again rechecked in a few weeks to correct any changes that may occur owing to tissue changes and a settling of the dentures. The postponement of the final grinding in, or the insertion of dentures that are not properly ground in, will cause the formation of habits that will later be hard to overcome: shifting of the dentures, with soreness of the underlying tissues, and a resulting tissue change. The details of the technic are the same as they were ten years ago. It seems that, in the matter of technic, there could be many changes made that would mean an improvement in the technic without affecting the principles. True, a change does not necessarily mean an improvement, but with the advancement made in prosthetic technic in the last ten years, it would seem that there could be some changes with improvement in this technic in that length of time.

A. Wolfson, Newark, N. J.: In the discussion of a paper such as Dr. Keyworth's on the Monson technic for full denture construction, one may readily assume one of two points of view. The conventional point of view would be simply to express one's opinion of the technic in all its details as presented by the essayist. Were I to do that, I should be inclined to say that the entire paper has been very carefully worked up and the technic nicely presented. Without attempting to be facetious, I believe Dr. Keyworth's paper would do very admirably as a prospectus to be sold in conjunction with the Monson instrument and would serve well any one who wished to adapt himself to the Monson technic. Dr. Keyworth is unquestionably a painstaking technician and, in presenting every detail of the technic, he makes it possible for the beginner to appreciate the niceties of one of the many methods of anatomic articulation, so-called, now in vogue. So much for the technical aspect of the paper. I am much more keenly interested in the whys and wherefores of anatomic articulation, together with the larger problem of occlusion. Viewing the paper from this angle I dare to be more critical. In the first paragraph of Dr. Keyworth's paper, he states that the Monson technic "is based upon the spherical principle of occlusion, which is the result of research by George S. Monson." Parenthetically, at this point I might say that whatever research Dr. Monson has done has not come to my attention nor has it generally been accepted as yet by the scientific world. Reviewing the entire and controversial feeling regarding anatomic articulation, we can roughly divide all of the outstanding schools of thought into two: one in which the occlusion is made the master of the situation; and the other, in which the condylar movements is the key to the situation, with occlusal relations subservient thereto. Merely by way of illustration, we are safe in pointing to the Monson technic as the champion of the first, and the Hanau technic of the second. Members of the Section on Full Denture Prosthesis of the American Dental Association are cognizant of the amiable way in which these two schools of thought have tried to get together for common discussion in the past. All so-called scientific systems of aid in the practice of our art are based upon a preconceived idea, called a theory. A theory evolves from a series of observations which appear to represent a definite fact in Nature. In the particular case of the Monson technic, the following quotation from Dr. Keyworth's paper explains the basis for the theory. "If an examination is made of casts of the natural teeth, it will be noted that the occlusal surfaces of these teeth conform, in general, to the surface of an 8 inch sphere, both anteroposteriorly and buccolingually." In the case of the Hanau technic, called so merely for convenience, the evidence is gathered entirely from clinical observation. Consider for a moment the position of the general practitioner in den-

tistry who has to decide for himself the technic that he will follow in his full denture work. Both technics are precise; both technics are elaborated by instruments, and both are definitely backed up by research work and scientific evidence gathered from anatomic sources as well as from clinical evidences. Both technics have their followers, and each technic is the more popular in accordance with the geographic location, the enthusiasm of the leader or the particular leanings of the men arranging scientific programs. This, of course, makes an intelligent consideration of full denture problems about as satisfactory as an attempt to arrive at a fair choice in a political campaign. Are we, therefore, necessarily doomed for the rest of our professional career to make our technical choice, influenced by enthusiasm, propaganda or even a display of finished results, as is in vogue today, or may we hope for an opportunity to face the problem constructively and intelligently? The responsibility of solving the problem of occlusion in full denture work, which is, of course, intimately connected with other problems of occlusion in other branches of our art, rests upon the shoulders of the very leaders who are now at logger heads. A round table must be built big enough to accommodate around it George S. Monson, Rudolph Hanau, Needles, one Wadsworthian follower, Campbell, Gritman and several others of a kind who can approach this problem in the same spirit in which the bacteriologist and chemist approaches his. After a preliminary discussion, clinical material would have to be available and several technics tried out on a selected group of patients. In this manner, we may hope for the establishment of one of the following truths: 1. Occlusal relations are the key to the situation and guide jaw movements. 2. Condylar inclinations guide jaw movements, making occlusal relations subservient thereto. 3. Neither of the foregoing is true, and a great deal of latitude is possible between these two extremes. It is my sincere hope that all of us may live long enough to see this accomplished.

Dr. Keyworth (closing): I will answer Dr. Wolfson's discussion first because it will take the least time. The chairman of this section requested that, as far as possible, consideration of condyle movements and condyle adjustments be omitted from my paper on full denture technic. For that reason, that section of the paper was made as brief as possible. Dr. Wolfson's discussion, with the exception of a few minor points, is a discussion of instruments and adjustments, and is not a discussion of the paper. The question raised by Dr. Dressen in relation to muscle, or tissue, trimming the peripheral border of the impression is a point that has been discussed for some time. We of the Monson group do not advocate a tissue trimmed impression, for this reason: We believe in restoring the normal relationship of the mandible to the maxilla, and in so doing, it is often necessary to open the bite. This opening causes a gradual change in the position of the tissues at the peripheral border of the denture, and the established relation of these tissues to the periphery is not maintained. Therefore, a valve seal in the firm, immovable tissue on the greatest convexity of the ridge is advocated. In this way, the periphery of the denture may be trimmed to accommodate changing conditions. The method shown for establishing the centric relation is one which seems to prove most efficient in the hands of a great number of operators. It was a pleasure and a privilege, to some of us, to see a demonstration of a new method of recording centric relation by Dr. Stansbery, before the National Society of Denture Prosthetists. He showed a very reasonable method of accomplishing this, but I cannot say more about it until it has been more generally used. I agree with Dr. Dressen that many cases could be mounted without a transfer bow. However, in dispensing with the transfer bow, asymmetrical cases are not mounted in the correct relationship to the mechanical center on the instrument, and as the degree of asymmetry is not apparent until the case is mounted, it is best to use the transfer bow in all cases. The statement was made that the bite could not be opened or closed on any instrument without destroying the correct occlusal contact. Casts of natural teeth can be checked, with checkbites made in the mouth, in either an opened or closed relation; which proves that the degree of opening, in full denture cases, can be altered on this instrument without producing any discrepancy in the occlusion. The criticism has been offered that nothing new has been instituted in this technic in the past ten years. This is not true. Many changes

have been made, but most of them have been discarded as impractical for teaching purposes. The technic described in this paper is the one which has proved the most efficient in the hands of a great number of dentists. The Monson group is always striving to perfect a technic that will be acceptable to the man of average skill and ability. There are many things used by individual members of this group in their technical procedure which are not described in this paper, the reason being that, while these methods may be of value to certain individuals, they are not practical to the majority. The technic we wish to teach is one that will be proficient in the office of the general practitioner.

The Journal of the American Dental Association

58 East Washington St., Chicago, Illinois

C. N. JOHNSON, Editor

Published by the American Dental Association

All expressions of opinions and all statements of supposed facts are published on the authority of the writer over whose signature they appear, and are not to be regarded as expressing the views of the American Dental Association, unless such statements or opinions have been adopted by the Association.

Communications intended for publication in the scientific or literary pages of THE JOURNAL should be addressed to the Editor. All advertising or business matters should be addressed to the Business Manager.

Subscription is included in the annual membership dues. To nonmembers living in the United States or its possessions, the price is $2.50 a year in advance; Canada, $3.00; Australia, $4.00; other countries, $3.25. All foreign subscriptions are to be paid in United States money.

Editorials

THE NEW YEAR

What a wealth of possibility there is in the New Year! As we look forward to it, we like to visualize all the wonderful things we may accomplish during the next twelve months, and this is well. Without an occasional check-up or appraisal we would likely fall in a rut and glide along in the beaten path indefinitely. Routine is so attractive that it comes nearly being our greatest handicap.

We need some event or some particular period of time to make us pause and note the direction in which we are going, because the direction is more important than anything else. Of one thing we may be sure, that we shall never stand still: we either gain ground or lose it.

The New Year is proverbially a time of resolves. We make resolves as naturally as we breathe; we even make a routine of our

resolves; so much so that our resolves do not leave a very profound impression with us. And yet mayhap we are better for making them.

The coming year is one of the most propitious that the American people have ever faced. It holds within it the promise of greater achievement than any previous year in our history. Our people were never so prosperous, nor was their prosperity ever based on such an apparently firm foundation. There are fewer signs of discouragement and unrest on the horizon of 1929 than we have ever noted at the beginning of any previous year. Of course, this must be borne in mind: that some aberration of man or nature may quickly cloud the sunshine of the future, and precipitate calamity in our midst. Constant vigilance on the part of man and constant trust in the ultimate good of nature must be our watchword on approaching the portals of the New Year. Man has steadily advanced from a condition of abject misery and barbarism to his present state of partial emancipation. He has not reached the goal, but he is well on his way. Nature has given humanity some terrible experiences, but, on the whole, nature has been kind and has sustained man in the face of his many imperfections and his countless blunders.

The year 1929 holds within it the rainbow of hope, and across the starry sky is written the promise of greater things to come. There never was an age so wonderful as this, and never one so prescient. Men are doing things today as mere routine that the decades of the past would have pronounced miraculous; and the end is not yet. Out of the filmy haze of the approaching year, the figures and forms of future achievements are taking shape, and the accomplishments of the past are only an earnest of what we see in store for the days to come.

The thing we most need at this time—and the New Year is quite appropriate for this purpose—is to winnow selfishness out of our hearts, and broaden our charity for our fellowman. This earth would be a paradise if the hearts of men were all in the

right place, if every man treated every other man as his brother, and if loving kindness formed the *motif* of our every act.

With Christmas come and gone,
And New Year beckoning on;
Let's hail with cheer
The coming year,
And sail serenely on.

THE REPUTATION OF THE DENTAL PROFESSION

In every way possible, the good name of dentistry should be conserved. The reputation of any profession is a real asset to its members, provided the reputation is good. The impression made by our various dental societies on the citizens and officials of the cities where we meet is a rather fair barometer of the reputation that organized dentistry is getting among the people at large, and it is a source of great gratification to be able to record that, for the most part, this impression has been very favorable.

This was first conspicuously made manifest at the 1925 meeting of the American Dental Association at Louisville, where the citizens gave spontaneous expression to their admiration of "the character and gentlemanly bearing of the attending members." The managers of hotels were particularly free in commending the general demeanor of the dentists. As one of them wrote the officials after the meeting: "From a hotel standpoint, it was one of the most successful conventions which we ever handled."

There has never come to the attention of the officers a single derogatory comment on the conduct of our members following any of our annual gatherings, and this is in some contrast with the experience of certain other organizations. Every comment made has been favorable, and all have come spontaneously without suggestion on the part of our members.

After the Minneapolis meeting, Dr. Harry W. Nelson, Chairman of the Local Committee received from Mr. A. F. Spencer of M. F. Patterson Dental Supply Company a letter which we quote:

Dear Dr. Nelson:

I am quite sure you will be personally interested in the following statement made to me by Mr. Chas. G. Davis, Director of the Hennepin County Law Enforcement League. Mr. Davis is an old friend of the writer, and he is a most sincere and earnest worker in the cause he advocates and devotes his time to.

In a conversation with Mr. Davis since the National Meeting, he remarked that the convention of dentists here last week left a most favorable impression, and that the personnel must be very high grade and of a high type.

He further went on to say that during the convention his operatives and service had less complaints of improper conditions, drinking and other evils than they have had during any convention held here in Minneapolis within the year.

You have no idea of how pleased and satisfied personally I was at such a wonderful endorsement of the A. D. A., as well as of the A. D. T. A., for as you well know, at a convention, the ordinary citizen does not differentiate between the professional and commercial, insofar as impressions are concerned.

Mr. Davis, please understand, had no reason to tell me this other than that he was pleased with the conduct of our visitors last week. Neither would he say such a thing unless he meant it.

I am passing this along to you to do with as you may, for I have had permission of Mr. Davis to quote him.

A statement of this kind coming without solicitation from a public official is not only gratifying but is also a very accurate index of the impression made on the people of a community by our members, and in that respect it is most significant.

No one familiar with the rank and file of dentists would care to claim that they are a lot of saints. They have their faults and their frailties as have other men, but if they continue to conduct their meetings along lines that bring out voluntary expressions of approval such as we have quoted, they may at least lay a claim to the reputation of being decently behaved in public, and to that extent they contribute to the status of the profession in the public mind.

In this respect, there is a serious obligation devolving on every man who attends dental meetings to so conduct himself that no reflection shall be cast on the profession through his peccadillos.

The status of the profession will never be higher than the individual members place it, and it will never fall below the standards set by them. Among all the obligations assumed by an individual when he accepts a diploma to engage in a professional career, not the least is that of maintaining at all times the essence

of respectability and decorum; and this applies with especial force when he is attending the meetings of his own calling. If a dentist must be base, if he must misbehave, if he must drink, let him have the consideration to do so at other times than during the sessions of dental organizations.

Parenthetically, it might be well to suggest, without the least idea of moralizing, that he early train himself not to indulge in these things at any time. If the highest expression of correct living is needed anywhere, it is needed in professional life, and the dentist who contributes to this is an asset to his profession, while the one who ignores it is a liability. Whenever it is noted that a dentist is at all disorderly or in any way off the beaten path of respectability, as has occasionally happened, it always brings embarrassment to the reputable men present, because in their heart of hearts all of our members admire respectability and correct conduct, and deplore any deviations from it.

THE THIRD LATIN AMERICAN DENTAL CONGRESS

There will convene, July 20, 1929, in the city of Rio de Janeiro, Brazil, the Third Latin American Dental Congress. The two previous congresses, held, respectively, in Montevideo and Buenos Aires, were very successful. Rio de Janeiro is said to be one of the most beautiful cities in the world, and it should attract an unusually large attendance.

We suggest that a visit to Brazil at this season of the year would be most enjoyable to residents of the northern hemisphere, and we trust that many may go from the United States. July is vacation time with North Americans, and the climate of Brazil at this season is tropical winter, and is therefore ideal. The President of the Congress is Dr. Frederico Eyer, of Rio de Janeiro, and his address is Avenida Rio Branco 142. Particulars about the Congress may be obtained from him.

BUREAU OF CHEMISTRY

ATOMIDINE

ATOMIDINE, "a water soluble Iodine Compound" is offered to the dental and medical professions by Schieffelin and Company, New York. It is claimed that

> Atomidine is a preparation standardized to liberate 1 per cent of iodine in an Atomic or Nascent form when in contact with tissue.

Beyond this and similar generally uninforming statements, no indication as to the qualitative or quantative chemical composition of Atomidine appears in the advertising material. Such secrecy as this gives a certain mysterious glamor to the preparation if one is prone not to think too carefully.

The product has been circularized widely among the medical and dental professions. In a booklet sent to physicians under the heading "Iodine in the Atomic State," appears the following:

> Atomidine is the outcome of twelve years of research and its production bids fair to create greater possibilities than had been anticipated. The therapeutic potentialities of iodine in an atomic state not only exceed those of pre-existing forms of this remedy, but, in addition, reactions appear that were unknown in the latter.
>
> Atomidine might well be considered a new drug, and therefore cannot be too closely compared with the known forms of iodine.
>
> Because of its ready assimilation, minute doses are sufficient to produce therapeutic effects. This is quite contrary to the iodides of which nearly eighty per cent are excreted unchanged. No massive dosing becomes necessary, thereby obviating depressant and toxic reactions.

In this connection, it might be pointed out that, according to such an authority as Prof. Torald Sollmann, dean of the Medical School of Western Reserve University:* "Elementary iodine is eventually converted into iodide, but first combines with the proteins of the cells. . . ." And "Free iodine cannot be formed at the alkaline reaction of the tissues; and if introduced, it cannot persist but is rapidly converted into iodide and protein compounds." Hence, if free or "atomic" iodine is liberated as claimed by the Atomidine promoters, it acts in the system as an iodide.

Further claims of a medical character made for Atomidine are:

> Atomidine exerts a true germicidal effect in infections of the body.
>
> It is an active and efficient gastrointestinal antiseptic.
>
> It has the property of reducing blood-pressure in case of hypertension.
>
> Atomidine is an efficient diuretic and urinary antiseptic, acting in either an acid or alkaline medium.
>
> It undoubtedly activates general metabolism, stimulates endocrine function and cell secretion. . . .

As far as our records go, all of these claims are made without a scintilla of printed scientific evidence to substantiate the claim that Atomidine is superior or even the equal to tincture of iodin or

*A Manual of Pharmacology, 3rd Edition, pp. 883 and 887.

of the other iodin products of the Pharmacopeia.

As regards the dental claims, the approach to the dental practitioner is more abrupt. The dentist is acquainted with the uses of Atomidine by a circular enclosed in the trade package.

The claim is made:

Atomidine is the remedy of choice wherever a powerful non-irritating antiseptic and germicide is required.

Atomidine, together with a thorough prophylactic treatment, is very beneficial in the treatment of pyorrhea. Its continued use will arrest the most stubborn cases.

. . . if all soreness of gums has disappeared, the patient can be dismissed as *cured*. (Italics ours.—Ed.)

One may well ask whether the prophylactic treatment would not play a very large part in the treatment. The modern dentist will insist on adequate evidence before accepting a remedy which is claimed to *cure* pyorrhea!

It has already been mentioned that Atomidine is heralded as the result of twelve years of research. Yet, recourse to the chemical and medical literature for the past twelve year period fails to bring out published data on the chemical composition, and evidence for the claimed advantages of Atomidine over pharmacopeial iodin preparations. This alone should cause the profession to look on the claims for the product with considerable skepticism.

If this alone does not cause one to look askance at the product, we find, on a perusal of the Atomidine advertising matter, the following paradoxical situation. In its literature, Atomidine is stated to be "controlled to liberate 1% Atomic Iodine in solution." But, in a booklet circularized to the medical profession, we read the following contradictory statement:

Iodine in the nascent form does not permit of chemical analysis. It is one of Nature's fleeting, transitory states.

How, then, we are privileged to ask, is Atomidine "controlled to liberate 1% atomic iodine. . . ."?

As no information concerning the qualitative and quantitative composition of Atomidine was given, it was submitted to the A. D. A. Chemist for investigation.

A. D. A. CHEMIST'S REPORT

"Three (3) original specimens of Atomidine (Schieffelin and Company, New York), price, $1.00 each, were purchased on the open market for examination.

"On the carton, the following appears:

Atomidine

A Water Soluble Iodine Compound Controlled to liberate 1% Atomic Iodine in Solution.

Atomodine contains: 1% available Atomic Iodine.

Atomidine is a water soluble iodine compound capable of liberating in contact with tissue 1% of Atomic or Nascent Iodine. Atomidine has proved more active, less toxic and less irritating than molecular iodine.

"On a circular which accompanies the bottle, the following appears:

Approximately 1/100 grain of iodine is present in one drop of the solution.

. . . 15 to 30 drops (one or two medicine droppers full) to 1/3 glass of cool water between treatments.

"The bottle contained approximately 50 c.c. of a clear, slightly yellow liquid, possessing a decidedly acid reaction. The specific gravity at 20 C. was 1.021.

"Qualitative tests indicated the presence of chlorid (Cl^-), chlorin (Cl^+) and iodin in the oxidized form (electropositively charged iodin) such as is present in iodates or iodin chlorid, and sodium. Sulphate, calcium, potas-

sium and other metals were not found. Organic matter was not indicated.

"The specimen dissolved in water yielded an odor resembling that of chlorin. On carefully exposing starch paper to the vapors from Atomidine, there was practically no coloration, but when potassium iodid paper was used, there was a deep coloration indicating chlorin (Cl^+—Cl^-) to be in the vapors. When starch was added to the diluted solution, the typical starch iodin color did not appear until a few drops of sodium thiosulphate or other reducing agent was added. As would be expected, iodin was not liberated when certain reducing agents were added to the alkaline solution, though the claim gives the impression that iodin is liberated in alkaline solution.

"Quantitative determinations yielded:[1]

Residue on Evaporation[2]	2.07%
Sodium (Na^+)	0.76%
Chlorid (both as Cl^- and Cl^+)	2.09%
C.c. of 0.02N $Na_2S_2O_3$ to combine with iodin liberated from potassium iodid by 1.0 c.c. Atomidine	16.60
Titratable acidity (calculated as hydrochloric acid)[3]	1.35%
Iodin (both as I^+ and I^-)	1.00%

"Calculating from the foregoing, the average dose, as recommended for pyorrhea treatment, from 15 to 30 drops in one third of a glassful of cold water would be equivalent to approximately 0.01 to 0.02 gm. (approximately one sixth to one third grain) iodin (in combined form). Each daily dose (three doses) would be equivalent to 0.03 to 0.06 gm. (approximately one half to one grain) of iodin (in combined form). By way of comparison, the average dose of tincture of iodin, U. S. P., is 0.1 cc., equivalent to approximately 0.11 gm. (1 2/3 grains) iodin; and of compound solution of iodin, U. S. P. (Lugol's solution), is approximately 0.13 gm. (2 grains).

"It was found that a solution having the essential chemical properties of Atomidine may be prepared by adding hydrochloric acid, U. S. P., 3 c.c., to solution of chlorinated soda, U. S. P., 50 c.c., and to the acid solution adding a solution containing sodium iodid, U. S. P., 1.2 gm., dissolved in 10 c.c. of water; and the volume then diluted to 100 c.c.

"Such a reaction may yield a solution containing various products. This reaction mixture may contain, among other things, iodin-monochlorid (or iodin trichlorid) iodic acid and free chlorin. A solution with somewhat the same chemical characteristics might be prepared by a reverse reaction of sodium iodate and hydrochloric acid. The amount of sodium chlorid in Atomidine appears greater than could be accounted for by the latter reaction. In any event, whatever is present, the end reaction in the presence of reducing substances (as are present in the body) would be exactly the same, namely, iodids; that is, iodin in the combined form as exists in potassium iodid.

"Therefore, from both a therapeutic and a chemical standpoint, as far as internal medication is concerned, there appears to be no justification for asserting that Atomidine would act differently from iodids. As far as topical application is concerned, there is no adequate scientific evidence that Atomidine is

1. The details of analysis will appear elsewhere.

2. The residue was shown to be almost wholly sodium chlorid.

3. This figure does not mean that all acidity is due to hydrochloric acid, but for simplicity the results were calculated to that basis.

superior or even the equal of tincture of iodin."

In our opinion, in view of the Chemist's report, it may be seen that Atomidine is an unnecessarily complex medium for iodin medication.

The impression is obtained that Atomidine obviates depressing and toxic reactions. One reason that Atomidine may not produce iodism is that, in the doses recommended, the iodin action is extremely feeble.

Until the distributors of Atomidine remove the secrecy under which Atomidine is marketed and furnish the profession with adequate clinical evidence to substantiate the claims made for it, the use of Atomidine, in preference to existing forms of iodin, should be frowned on by those dentists who wish to uphold rational dentistry.

BUREAU OF DENTAL HEALTH EDUCATION

DENTISTRY OF YESTERDAY AND TODAY*

By C. N. JOHNSON, Chicago, Ill.

I AM asked to talk today on the "Dentistry of Yesterday and Today." The dentistry of yesterday—even the immediate yesterday—meant, for the most part, the repair of damage already done. As a profession, we sat more or less piously—chiefly less—with folded hands waiting for disease to start so that we could pounce on it and suppress it. And in passing, I want to claim for my profession that we really did a very good job of suppression. We inserted fillings in decayed teeth many of which lasted a lifetime; we made crowns for broken down teeth too far gone to fill; we made bridges to span open spaces, and sometimes we cured pyorrhea—yes, we did. When at last, in spite of all of our efforts, the natural teeth were lost, we did not let the public go toothless—we inserted artificial substitutes, some of which, it is true, were artificial enough, and yet they looked better than "the great open spaces."

In other words, we tried valiantly to stand between the people and toothlessness, as a result of which the generation of the immediate yesterday had more presentable mouths, and were better equipped for mastication than would have been possible without the services of the dentist.

And yet in the same breath that we make this claim, we must admit that, in one respect, we failed most miserably in our highest mission to the public. All of this work was simply reparative; it was merely an effort to make the best of a bad situation; it did not essentially seek to change the situation. It was much like locking the stable door after the horse had been stolen.

The dentistry of today has a different mission. It is still called on to repair damage, because damage continues to be done, but its highest function and its greatest aim is to prevent disease instead of curing it. Prevention is the watchword of the hour both in medicine and in dentistry, and while it will require a long time to bring about actual prevention, that is the goal toward which the dentistry of today is directed.

In this connection, the question in the minds of the public most naturally is: How shall prevention of dental disease be brought about? And this is our answer: By intelligent cooperation between the people and the profession. Various agencies may be enlisted in the plan of prevention, one of which is a more intelligent diet for the people, and especially for expectant mothers, and for children. We have not yet come to a

*This and radio talks of Drs. Bunting Gallie, Puterbaugh and Adair and Miss Eyrich were broadcast during the Seventieth Annual Session of the American Dental Association, Minneapolis, Minn., Aug. 20-24, 1928.

full agreement as to an ideal diet, but we are on our way. First, we must recognize the fact that there is a personal equation in this as in everything else—that the same diet does not invariably produce the same reaction in all individuals, and yet there are some of the fundamentals of diet which we think we are learning, and which, when once fully comprehended, will result in greater sanity in our living habits. This will be one great aid in preventing disease, and yet it will take a long time to reform the diet of the masses sufficiently to render it fully effective for prevention.

What then can be done in the meantime? Very much can be done. I have said that cooperation is needed between the people and the dental profession, and the first and most natural question is: How shall cooperation be brought about? The initial move must be made by the people, or, to be more specific, by the parents. Dental decay is largely a disease of youth; that is, it, for the most part, has its incipiency during childhood. If every child were regularly taken to the dentist from the age of 2½ or 3 years, and the proper home care was given the teeth, the control of decay would soon become an established fact. And if this were followed generation after generation, we would soon have a generation almost free from dental decay. Early attention to the smallest defects in the teeth of children will minimize the tendency to decay in the mouth, and the time will soon come in the history of the child when very little decay will manifest itself, the mouth becoming practically immune.

This, then, is the promise which the dentistry of today holds out to the people of the immediate future. That it is possible of achievement has been amply demonstrated in the experience of many dental practitioners. In numerous families today, the young people are found reaching the twenties with teeth in excellent condition, at a period of life when their parents had lost many of their teeth. This is so generally the rule that it has established itself as a demonstrated article of our professional faith, and the sooner the people recognize this and profit by it, the better it will be for the coming generation.

The dental profession stands pledged to devote its best energies to the consummation of this signal achievement, and all it asks is that the people accept the opportunity and avail themselves of the service at their command.

The American Dental Association is meeting in Minneapolis this week for the sole purpose of so perfecting its members in the science and art of dentistry that they can better serve the people, whether in the necessary repair work that still remains to be done, or in the concrete application of those principles of prevention to which I have just referred. Their greatest hope is that the people may see the vision of what the profession has to offer in the way of prevention, because it is an accepted article of our modern faith that, in every activity in life, prevention is preferable to cure.

THE PREVENTION OF DECAY OF THE TEETH

By RUSSELL W. BUNTING, D. D. S., Ann Arbor, Mich.

AT this time when several thousand dentists are in annual convention at Minneapolis, the people of this community are undoubtedly reminded of dentistry and of their teeth. To the average individual, dentistry suggests pain and toothache—what Burns has called "the hell of a' diseases." Toothache is the cry of an outraged nerve of a tooth which has been uncovered by dental decay, the most common disease of civilized man. Dental decay affects from 85 to 95 per cent of our total population and is responsible for a great deal of discomfort and suffering at all ages of life. Its effects may extend far beyond the mouth and teeth to involve other tissues and organs of the body. Many people are crippled by infection of the joints, the heart, the kidneys and other organs of the body because of badly decayed teeth. Physicians are deeply concerned in the condition of the mouths of their patients, and whenever generalized infection is suspected, they are demanding x-ray examinations of the teeth to determine whether the infection is coming from that source. Tooth decay is therefore of far greater significance than the pain or dental disturbances which it may produce. The great frequency of generalized infection of the body from decayed teeth and the serious consequences which so often result have aroused a great deal of interest in the health of the mouth and have created a desire on the part of every one to prevent the occurrence of such a calamity in his own case. If decay of the teeth could be prevented or if all cavities in the teeth could be filled and checked when they are small, there would be little danger of contracting infection from the teeth.

Until recently, the only known means of controlling tooth decay was filling the cavities so as to stop the further advance of the lesions. Little was known of the means of preventing the disease other than keeping the teeth clean, and thereby reducing somewhat the opportunity for its occurrence.

Within the last three years, it has been found by dental research workers that decay of the teeth is an infective disease, and the specific organisms which produce it have been identified. The occurrence of dental decay is therefore directly dependent on the presence or absence in the mouth of these specific bacteria. This infection is very common. The greater majority of the people have it, and their teeth decay; but a small number are seemingly immune, their mouths being free from it, and their teeth do not decay.

Although the nature of the disease has been determined, the means of eradicating the infection of tooth decay still remains to be discovered. This question is now being studied by dental research laboratories, and if sufficient funds were available to pursue the problem in an intensive way, some practicable means of prevention of dental decay might be obtained. Perhaps some day a vaccine may

be found that will make all people immune to this disease, as has been done in the case of smallpox, typhoid fever and scarlet fever.

If decay of the teeth is an infective disease, its control must consist of the elimination of the specific bacteria from the mouth. One means of combating the organism is keeping the mouth and the teeth clean. It is evident that the cleaner the mouth is kept, the less opportunity bacteria will have to produce their specific effect; in fact, surfaces of the teeth that are kept continuously clean never decay. Consequently, the frequent cleaning of the teeth and mouth is a most practical means of preventing dental disease.

In addition to mechanical cleaning, there is another factor of equal and perhaps greater importance: namely, the type of foods which comprise the diet of the individual. As we study the various peoples of the world who do not have dental disease, notably the Eskimo, the African and the South Sea Islander, to see how they differ from those who are highly susceptible, we find that their diets are vastly different from that of Americans. We who live on highly refined, denatured and nutritionally deficient diets are especially prone to dental disease, while the races who, as a rule, live on the natural foods of their locality are immune. When these people adopt the refined diet of civilization, they too become subject to tooth decay.

In our survey of the mouths of various groups of children, we found the poorest dental conditions in children who came from the well-to-do families, and the best dental conditions in certain orphanages where the children for years had been fed on a simple, well-balanced diet; a rather sad commentary on life conditions for childern in our average American family. In certain of the public schools, every child had dental caries; while, in one orphanage, 65 per cent of the children were entirely free from that affection. The latter group had been fed largely on foods raised on the institutional farm. The diet was notable for its abundance of milk and vegetables and a minimum amount of sugar or candy.

In the light of our present knowledge of nutrition, we know that a child who is fed milk, cod-liver oil and orange juice during infancy is usually protected against rickets and other deficiency diseases. A child so fed will also have teeth that are stronger and more resistant to decay, and his mouth will probably be free from acidophilus infection. During childhood, the best dental conditions are observed when the child receives one quart of milk daily, plenty of green vegetables, a reasonable amount of hard foods that require vigorous chewing, and a minimum of sugar, candy and sweetened foods, such as preserves, cake and pastry. Most children obtain many times the amount of sugar that they need, and the habit of eating the popular chocolate confections which are so dear to the heart of the child unquestionably favors the growth of the bacteria of tooth decay. The diet should not be too soft, as the chewing of hard foods affords proper stimulus to bone development in the jaws of a child, and also acts as a cleanser of the teeth, greatly improving the hygiene of the mouth.

Certain drugs or mouth washes may be used to good advantage in reducing the infection of dental decay. As far as we know at the present time, there is but one which, when used by the patient as a mouth wash, is effective in this regard. This preparation is known as hexylresorcinol, more commonly re-

ferred to as solution S. T. 37. When diluted with four parts of water and held in the mouth for one minute at least once a day, it is distinctly inhibitive to the bacteria of dental decay. This treatment alone in many cases will eliminate the organism and will stop tooth decay.

Many other drugs will probably be found which may have a beneficial action similar to or even greater than that of solution S. T. 37, but, at the present time, this preparation is the only one known which is distinctly inhibitive to dental decay when used by the patient as a mouth wash.

Dental decay is much more prevalent in childhood than at any other time in life. It is during the early years that the greatest damage to the teeth is done, and, at this time, injuries may be incurred that will be carried throughout the life of the individual.

Although no system of prevention will afford 100 per cent success, it may be said that the average child, reared on a simple, well-balanced diet containing a minimum amount of white flour and sugar, will have much less dental infection and disease than he otherwise would have. With very little attention from the dentist, he may be brought to adult life with a full complement of teeth which have not been ruined by decay, as so frequently is the case.

MOUTH HYGIENE IN MISSISSIPPI

By GLADYS EYRICH, Jackson, Miss.

I HOPE some boys and girls are listening in, because I am going to tell you a few things from the boys and girls of Mississippi. They know that, up here, some of your schoolrooms get 100 per cent in mouth hygiene. Twenty-seven of our schools in Mississippi had all of their dental corrections made this last school term, too, so I bring you greeting from them.

One of the boys wants you to know what he learned from his dental hygienist last year. He brushes his teeth before he goes to bed and after each meal, down on the upper teeth and up on the lower teeth. He brushes his teeth and gums, using salt water with a small brush that costs 10 cents and comes all the way from Minneapolis.

The letter continues:

I visit the dentist every six months, and I get a dental certificate from him saying that my teeth are O. K.

You should see the milk, vegetables, fruits, cereals, brown or whole wheat bread that I must eat to build good teeth. The dental hygienist brought them to school one day and eight of us had our picture taken with them. I was holding the milk—a quart bottle of it because I drink that much every day or eat it on my cereal or in ice cream. I'd like to eat the whole quart in ice cream this weather because it is so hot.

Our grade went 100 per cent last spring and we were entertained at the picture show and ice cream factory. We liked that. There were 306 pupils in our school and every one of us got an ice cream cone free because we all had dental certificates.

I am washing my teeth all summer so that before school opens I can get another dental certificate, without having anything done to them.

Your friend, Billy Hamilton.

Billy is just one of the 86,000 children who had their teeth examined by the dentists in school last year. In Mississippi, the dentists give their time for this service.

Nathan is another one of our boys. He happens to be one of the 42 per cent who had good teeth when they were examined. He came to the hygienist from the kindergarten one morning saying: "I bet you won't find a speck on my teeth. I brush them morning, noon and night." "Do you drink milk, Nathan?" "I should say I do—four glasses a day!" "Do you eat vegetables?" "Yes, and green ones, too." I am glad to say that it ends happily as all good stories do: Nathan was one of the first in Vicksburg to receive his health button.

All of the boys and girls do not have so much confidence when they have their teeth cleaned. After one little girl had uneasily settled herself in the chair and the cleaning had begun, the hygienist said: "You see, there is nothing in getting your teeth cleaned to hurt you." With relief she replied, "No, it just has a smell in it."

During the meeting of the Mississippi Dental Association last spring, a dentist visiting one of the Jackson schools told the boys and girls never to take off their shoes until they had brushed their teeth; then, the next day, if the teacher asked, "Have you brushed your teeth?" and they had to say "No," the teacher would be sure they had slept in their shoes.

This story must have reached Vicksburg, for there the hygienist found a first grader who didn't want to have his teeth cleaned because he was afraid she would take his shoes off. Another little patient said, "I wouldn't mind your doing this even if you did take off my shoes."

During the cleaning, the child holds a little paper cup which he uses instead of the basin. A hygienist was cleaning 6-year-old Tommie's teeth. She told him to "spit out," whereupon Tommie proceeded to descend from his chair. The hygienist asked, "Why are you leaving, Tommie?" Tommie replied: "You told me to 'git out' "!

We try to teach the children and their parents that baby teeth are just as important as permanent teeth, and that, at about 6 years of age, each boy and girl gets four large permanent teeth behind the baby ones. Some of the children know that these teeth are often called the "6-year molars." Small Jimmie had learned that lesson well. After the dental examination, he went home and told his daddy that his "6-year motors" were all right.

These small boys and girls make work with them delightful. On one of my visits with the county nurse to a country school, we went into the primary room first. Those childern had been vaccinated against smallpox, diphtheria and typhoid, so when I arrived they thought I was a new kind of vaccine. Several times, the nurse was asked: "Miss Brown, what are you going to vaccinate us for today?" and each time she replied, "We aren't going to vaccinate you today." But that idea evidently spread throughout the school, because, at the assembly period, I faced a very tense audience of all grades. They didn't know exactly what was going to happen to them. Realizing that I could not get my story across until they were in a happier mood, I said, "Boys and girls, how many of you have mouths today?" All hands went up. Everybody did, but they didn't think it was funny. I then said, "What have you in your mouths?" They soberly replied, "Teeth

and tongue." Persistent still, I continued: "What do you do with your mouth?" They said, "Eat and talk." Almost losing courage that I should ever get a laugh out of them and be able to present my subject from the lead they gave me, I insisted: "Surely some one in this school does something with the mouth besides eat and talk." Apparently no one did. Then, out of the overwhelming silence, came a little voice that said: "Open and shet it!"

So I learned that day that I could both open and shut my mouth, but I don't want to do the latter until I say that this is the finest dental meeting yet, and I wish you all could see the health exhibits and visit the Mississippi booth.

WATCH THE CHILD'S TEETH

By DONALD MAC KAY GALLIE, D. D. S., Chicago, Ill.

NO nation can become great unless it is made up of healthy, happy people. This fact is becoming more apparent throughout the civilized world. Great interest is being manifested by officials and the public in the efforts to stamp out disease and improve the public health.

The Federal Government, state governments and municipal boards of health are passing health laws and promoting better sanitary measures. Every municipality is striving for a pure water supply. The manufacturing of adulterated and unwholesome foods and beverages is barred. Crowding of tenements is prevented or the condition is somewhat alleviated. Great attention is given to the disposal of garbage and sewage. People afflicted with infections and contageous diseases are isolated.

Much is written about personal hygiene and body cleanliness, but the laity reads or hears little about the most prolific cause of disease, namely, the unclean, diseased mouth containing decayed and diseased teeth. No matter how pure the water may be, how wholesome the food and pure the air, they cannot enter the system pure and wholesome if they have to pass through a diseased, unclean gateway.

What is more disgusting and revolting than a filthy mouth and breath so foul that it endangers the health of all who come in contact with it? Caries, or decay, of the teeth is the most common of all diseases that the flesh is heir to, and it is a disease increasing with advanced civilization. Primitive people were little troubled with decayed teeth. Some, namely the Eskimo, and the Maori of New Zealand, were practically free from it. Today, the prevalence of decay of the teeth is appalling. About 90 per cent of the school children of Germany, France, Great Britain, Sweden, the United States, Canada and the other advanced nations have decayed teeth and unhealthy mouths.

What a penalty we pay for such conditions. The decayed teeth and diseased mouth of the child are the most prolific carriers of the communicable diseases of childhood, such as diphtheria, measles, scarlet fever and even pulmonary tuberculosis.

The resistance of a child with diseased teeth is so lowered that he is susceptible to all kinds of sickness and has a poor chance of reaching adult life with a rugged constitution. Not only are many children having poor teeth physically defective, but they are also mentally defective. It has been conclusively proved that diseased teeth and unhealthy mouth conditions are the cause of more repeating in our public schools than any other condition, and much of our juvenile delinquency can be traced to this cause.

Perhaps no branch of the healing art has made greater advancement than has dentistry. University training is one of the requirements for entrance to a dental college today. It requires four or five years to complete the dental course. The dentist has become a very skilful operator in the field of reparative dentistry, but in spite of our knowledge of the sciences, and our skill as operators, we are falling hopelessly behind in combating the ravages of decay. We realize that we cannot cope with the disease by reparative measures; our only hope lies in prevention, and today every conscientious dentist is directing his best thought and energy to this end.

To succeed along this line of prevention, we must have the fullest cooperation of parents and children. You must realize the importance of mouth hygiene and oral prophylaxis. The late William Osler, the most eminent medical authority of his time, had this to say to a graduating class in medicine. "You have one gospel to preach, early and late, in season and out of season, and that is the gospel of a clean mouth, clean teeth and a clean throat. These three things must be your text through life." Charles H. Mayo has stated that a vast percentage of all diseases gain entrance to the body through the mouth and sinuses. Ernest E. Irons, dean of the Medical Department of the University of Chicago, has made the statement that one-half of the deaths from heart failure are due to diseased teeth. With such a warning, surely we have a right to expect a full measure of assistance from parents.

The question is frequently asked, "When should we start this campaign for prevention?" Start with the toothless infant. See that the little mouth is kept clean. When the teeth erupt, see that they are kept clean. At the age of from 24 to 30 months, the child will have all the baby teeth, twenty in number. About this age, the child becomes imitative, and he will readily learn to use the toothbrush. See that it is used night and morning. After about 3 years of age, take the child to the dentist at least twice a year for examination and the filling of cavities that may have developed. Do not neglect these baby teeth. They should be retained in the jaw in a healthy condition until they are shed by nature. Remember that many of them are not shed by nature until about 12 years of age. If they are neglected, decay will penetrate the pulp, sometimes called the nerve, causing abscesses and necessitating premature extraction.

This will not only impair the function of mastication, but will also frequently cause the permanent tooth to erupt out of place. Between 6 and 7 years of age, there will appear in the mouth four large teeth, two above and two below, just behind the last baby teeth on each side. These teeth are the first permanent molars, sometimes called the 6-year molars because they erupt at about that age. Watch these teeth vigilantly. Their loss would be a tragedy. In many respects, they are the most important teeth in the mouth.

Following the eruption of the first molars, we have the shedding of the anterior temporary teeth, followed immediately by the eruption of the permanent incisors. Then the temporary molars are shed, and next the bicuspids. At about 12 years of age, the second molars erupt, and at about 13, the cuspids, the keystones to the arch. Many children, both boys and girls, at this age are still careless about their personal appearance, and unless parents watch them and see that they visit the dentist at regular intervals, there is liable to develop in these newly erupted permanent teeth cavities that will in a short time involve the pulp and will be followed by an abscess at the root end. The number of children who before the age of 13 have abscessed teeth is appalling.

In this campaign for better dental health and prevention of mouth diseases, we look to our grade schools to solve the problem. We ask you to use your influence with municipal authorities, school boards and departments of health to institute in all our grade schools, public and parochial, instruction in mouth hygiene, toothbrush drills, thorough examination of the teeth and surrounding tissues and the sending of reports to the parents. It is our hope that, in every community, means will be provided to care for the dental needs of children whose parents are unable to pay the regular professional fee.

HOW TO PRESERVE YOUR TEETH

By P. G. PUTERBAUGH, D. D. S., Chicago, Ill.

THE most common physical defect in American people today is decayed teeth. This was brought to our particular attention during the examination of recruits for military service during the World War. Since that time, statistics which have been compiled from the examination of school children and others fully confirm this statement; for 95 out of every 100 children in public schools have decayed teeth.

Looking backward through the centuries, we are impressed with the fact that, as far as history records, people have suffered from decayed teeth and diseased gums; perhaps not so nearly universally as they do today, but skulls that have been preserved show unmistakable signs of dental decay and pyorrhea.

Our cousins, the monkeys and chimpanzees, have good teeth while living in their natural state but quickly develop decay and pyorrhea when placed in captivity. All through the animal kingdom, we find that, while in their natural surroundings and eating uncooked foods, animals have little trouble with their teeth.

Uncivilized tribes of mankind who live principally on uncooked roots, herbs, fruits and meat have little trouble with the teeth. This seems to be the result principally of two facts: The vigorous chewing of tough fibrous foods mechanically cleans all surfaces of teeth and leaves them highly polished after each meal, and the sticky sweets in which their civilized brothers indulge are avoided. Also, these so-called savages really do polish their teeth regularly with green sticks, the ends of which are pounded to

a pulp and dipped in ashes from their campfires.

In modern civilized mankind, we find teeth deteriorating quite rapidly. With 95 per cent of our school children suffering from decayed teeth and consequently undermined health, it is high time that we begin to do something to prevent this most prevalent disorder which threatens to handicap the coming generations. At the present time, there are enough cavities in the mouths of the American people to keep our 60,000 dentists busy for more than 100 years even though no new cavities form; so the problem is too big to be solved merely by reparative processes.

If it were only inconvenience and personal disfigurement that result from decayed teeth, the outcome would not be so serious; but when many systemic ills are traced to decayed teeth, and we are brought face to face with the fact that many people are figuratively digging their graves with their teeth, the question begins to assume an entirely different appearance.

The adage that a clean tooth never decays is literally true. Those people who live largely on a diet of fruits with only a small amount of cooked starches and sugars have very little tooth decay. Those who eat largely of well cooked foods of the rice, potato and oatmeal types require the frequent services of a dentist to repair the constantly forming cavities. All foods made of white flour are hard on the teeth. This includes white bread, pastries and cakes. When eaten in excess, candies are bad for the teeth, because sugar is so readily fermented into lactic acid, which produces decay.

The greatest menace to our teeth at this particular time is the fact that most of us eat merely to satisfy the caprices of our appetites and not with any definite plan in our choice of foods. It is true that our bodies are able to utilize and work into energy a wide variety of foods; but a little intelligent effort in the selection and proper chewing of food would do much toward the making of sturdy bodies.

Those foods rich in vitamins, coming from all garden vegetables and fruits of all kinds, especially uncooked apples, should be eaten in season. Enough whole wheat bread and good butter to act as filler is permissible; but, above all, for your teeth's sake, finish at least two meals a day with a salad, and eat an apple each night, before retiring.

Teeth need the same care as other eating utensils. They should be brushed every time they are used. Soap and water are insufficient; chalk, salt, soda, etc., are insufficient when used alone. Preparations designed for use on toothbrushes are called dentifrices. A good dentifrice should contain some soap for the purpose of dissolving the oily film which attaches itself at each meal to the surfaces of the teeth. It should contain some chalk or other polishing powder for the purpose of maintaining a brilliantly lustrous surface to which food cannot easily adhere; and it should be pleasantly flavored and impart a sense of mouth comfort after its use.

A medium sized toothbrush is best, as it can be carried around the back teeth, where brushing is needed most, without discomfort.

Gums need to be brushed as much as do the teeth; for, in the absence of proper stimulation, the gums become soft, flabby and sensitive, bleed under slight pressure and soon fall a prey to infections, which, if permitted to go unchecked, will cause the ultimate loss of the teeth.

The toothbrush should be made to sweep the teeth free from accumulations in the same manner that one would sweep dirt from a hardwood floor; by sweeping with the cracks, not across them. The use of the brush as a vibrator is most excellent. This is done by placing the brush against the teeth at the gum line and without moving the bristles from the spot forcing them between the teeth with short vibratory motions, giving fifteen or twenty vibrations at each place. Use plenty of tooth paste or tooth powder on your brush, carry it to place on both cheek sides and the tongue sides of the teeth, and, with sweeping motions over gums and teeth, sweep every particle of food from the crevices and leave the enamel surfaces brightly polished. Finally, tepid water should be forced back and forth through the spaces between the teeth to free them from all residual material, just as dishes are rinsed after they are washed.

If teeth are regular in their arches, the use of dental floss is unnecessary. Mouth washes are for use after teeth have been extracted or in diseased mouths; they are not recommended for healthy mouths. Do not be misled by the advertisements that certain tooth pastes or powders will cure pyorrhea; they will not. Pyorrhea needs the attention of a skilful dentist just as do the cavities of decay in teeth. Do not waste your money nor valuable time experimenting with advertised pyorrhea cures.

Remember that three minutes bestowed on your teeth after each meal and a visit to your dentist once a year will pay most valuable dividends in mouth comfort, better health and a longer and happier life.

WHAT THE PATIENT SHOULD KNOW ABOUT PYORRHEA TREATMENT

By ROBIN ADAIR, E. S., M. D. D. D. S., Atlanta, Ga.

ALTHOUGH there are many thousands of dentists now visiting in this glorious city of the Midwest, it would not do for any of you to have the toothache. Not even your local dentist would be in his office to help you; for we are all gathered together searching for newer and better methods to relieve humanity of mouth diseases and toothache.

One of the most important subjects which will be discussed from every angle will be that of pyorrhea. Now the dentist knows this condition by a longer name, periodontoclasia. I will not ask you to remember this. It simply means the breaking down of the tissues around the tooth. The dentist who gives special attention to this particular disease is known as a periodontist, that is, a dentist who treats diseases which occur around the teeth.

You have heard some dentists, and many of your friends, say that pyorrhea cannot be cured, but they are simply misinformed. It is being cured in the offices of prominent dentists and periodontists every day. If your gums bleed on brushing; or if pus is exuding from the gums when you press them; or if a bad odor emanates from your mouth, you may be reasonably sure that you have pyorrhea,

and you should lose no time in having your denist or periodontist treat the case.

He will clean the surfaces of the teeth to remove the tartar, which accumulates like barnacles on a post in the water. These barnacles, any boy who has tried to climb one of these posts knows, will lacerate the hands or feet. So it is with the tissues around the teeth. When this accumulation irritates the gums, it causes a congestion which makes them readily bleed.

To relieve this condition, the dentist scales or planes the surface of the teeth. If the so-called pyorrhea pockets are present, the operation may consist of removing the flap of gum or laying it back, which more readily exposes the inner surfaces of the teeth. No matter how thorough this operation may be, the success of the work depends absolutely on the cooperation given the dentist by the patient after treatment. Of late, many periodontists refuse to accept a case for treatment until the patient shows that he can master an efficient system of brushing the teeth, or, rather, of stimulating the gums; for the simple brushing of the teeth is not sufficient to keep the mouth in good condition.

In the old days, when we chewed our food, the gums were exercised and kept in a hardened and perfect condition; but, in the present, we would dismiss our cooks if served anything which required proper mastication. If we put our arm in a sling, it soon atrophies; and this is what happens to the gums these days from lack of stimulation.

We can't take our gums out and walk them up and down the street, or play tennis with them, but we can substitute for exercise by stimulation with the toothbrush, which, to the gums, is, in effect, what exercise is to the muscles. This method is known as gum stimulation or physical culture of the gums.

It sometimes takes the dentist, or periodontist, several sittings of training before the pupil can master an efficient method of handling a toothbrush. However, it is well worth while, and patients should ask for and receive this instruction whether they have a diseased mouth or not. No operator can guarantee a cure, that is, an immunity bath. The same neglect which causes the disease in the first place will often cause its recurrence, even more readily, after the dentist has shrunk the tissues around the teeth; so it is absolutely necessary, from a health point of view, that this active treatment be carried out thoroughly and sufficiently by the patient. Certainly no less than three minutes in the morning and three minutes in the afternoon should be given the treatment.

One of the best methods to measure this time is to secure from the novelty store an egg-timer. At first, you will be surprised to know that probably you have brushed your teeth only half a minute, and you may become very tired in an effort to keep up this exercise for three minutes.

Now I have told you something of the necessity of caring for the pyorrheic mouth. While the results are very good, we can tell you that it is far more important to prevent pyorrhea than to cure it. Often, we may not be able to relieve pyorrhea; but we know that we can acquire methods that will positively prevent the disease.

And this great message I will leave with you from the Section on Mouth Hygiene and Preventive Dentistry of the

American Dental Association: It is far better to prevent pyorrhea than to wait for the disease to attack the mouth; for, when it does make its attack, very frequently it leaves in its wake rheumatism, neuritis, infection of the eyes, heart trouble, kidney lesions and digestive disturbances.

My message may be summed up in this simple sentence: "To cure is the voice of the past, but to prevent is the divine whisper of the future."

THE TOOTH QUESTION*

By GEORGE H. WANDEL, D.D.S., Chicago, Ill.

AT last the hustle and excitement of the election are memories of the past. We can now settle down to the consideration of personal matters, among which the question of health is always of vital interest.

Until recent years, the medical and dental professions have been practiced largely upon the basis of treating disease as it presented itself. Now, there is a new practice, a new hope taking form, which is going to show a definite beneficial effect on the health of the nation. The keynote of this progress can be summed up in one word, prevention. The prevention of disease has been definitely adopted as the watchword of the professions of medicine and dentistry. A determined effort is being made to establish those factors responsible for disease, and to teach parents and their families how to avoid them.

It is a commonly accepted idea in the dental profession that there is an ever increasing evidence of tooth trouble. There are few people who escape it. It is also a universally accepted theory that much of the tooth trouble we have after we are "grown-ups," comes as a result of neglect in childhood.

It has been my privilege, during the past five years, to be associated with a work that had as its aim the prevention of disease. This prevention program assumed, and rightly, too, that the earlier in the life of the individual it is possible to protect him against disease, the greater the probability that he will approach the age of maturity with a healthy body. With this idea in mind, much of our effort was directed toward the mother and the child. This work was carried on in one of our middle western states. Thousands of mothers were interviewed and instructed, and thousands of children were examined for physical irregularities. Every walk of life was reached in every type of community. I believe that it would interest you to hear what the results of our investigation disclosed as to conditions existing in the mouths of these children.

For instance, thousands of children, ranging in age from 6 months up to 6 years, were examined. We found that an average of 61 out of every hundred of those children had decaying or defective teeth. We also found that only an average of three out of every hundred had ever been to a dentist, and most of those three had gone primarily for the relief of pain or the removal of an ab-

*Radio talk, broadcast in Chicago, Ill., Nov. 9, 1928.

scessed tooth. We found many children under 2 years of age with diseased teeth, and a large number under 18 months of age with very apparent need for dental attention. At the same time, many school children were examined, and even worse conditions were observed. Ninety-five out of every hundred had one or more (usually, it was more) decaying teeth. Many of the children examined had abscessed teeth that were draining poisonous materials into the blood stream. The sad thing about it all was that nothing was being done to correct these conditions. Only an average of five out of every hundred of these children had ever had any kind of dental attention, and most of that was for the relief of pain or the removal of a tooth.

The only way to overcome these appalling conditions is to practice the rules of prevention. What are those rules?

1. The time to begin worrying about a child's teeth is before he is born. The first set of teeth begin their formation as early as the third month of fetal life. The crowns of four of the second set of teeth have begun to form as early as two months before the child is born. This means that, to safeguard these teeth in their early development, the health of the mother must be guarded from the very start. She must have proper medical and dental care. She must eat the right kind of foods, foods that will supply plenty of lime for the building of the child's skeleton and teeth. She should get plenty of fresh air, outdoor sunshine and a reasonable amount of exercise.

2. If it is at all possible, the child should be breast fed. As he is gradually being weaned and is being fed more and more from the various groups of foodstuffs, he should receive foods which promote normal growth and development. The foods of especial value to the mother and child (as its age permits) are milk, leafy and other green vegetables, fruits, eggs (especially the yellow of the egg), whole grain products and a reasonable amount of sweets and pastries. Time will not permit me to go into any detail about these foods.

3. Plenty of fresh air and outdoor sunshine are also in order. This does not mean sunshine coming through a window pane, because such sunshine has lost a valuable "something" that is responsible for proper use of lime by the body for building bones and teeth. It must be sunshine such as we get outdoors. There are, however, several new kinds of glass on the market which will permit the passage of a large percentage of those health giving rays of sunlight. Such a pane of glass would be especially valuable during the colder days of the year.

4. Proper home care of the teeth should be given from the time the teeth begin to come through the gums. They should be carefully cleaned morning and night, emphasizing the night care.

5. Every child should be given regular attention by a dentist from at least 2½ years of age. He should be taken to the dentist at least every six months, oftener if he is showing any marked tendency to tooth trouble. Usually, no two children can be treated the same in this respect. Some children need much more dental attention than others. Each child's dental attention should be governed entirely by the conditions and tendencies found in his mouth.

I wish I had more time to talk to you. There are many things I could tell you about this tooth question. However, I have enjoyed my little chat with you,

and I hope I have given you some information of value. Remember this, the greatest age for "prevention" is in childhood. It is my earnest hope that, as time goes on, knowledge of prevention will become the property of every parent and child upon this globe, to the ultimate result that every child in every land may look into his future with a smile on his face.

CURRENT LITERATURE

EXTRACTS AND ABSTRACTS

Trichlorethylene Treatment of Trigeminal Neuralgia: The anesthetic effect of trichlorethylene on the trigeminal area, according to the report of Ignaz Oljenick (*J. A. M. A.*, Oct. 13, 1928), was discovered by accident during the World War, when men using this substance to remove grease from machinery exhibited symptoms of vertigo, nausea and slight swelling of the optic nerve, but particularly anesthesia of the trigeminal nerve, which was isolated in its sensitiveness to the compound, the neighboring regions, occipital and cervical, being unaffected. Experimentation with tetrachlorethane, a similar compound, showed that, unlike trichlorethylene, it caused respiratory irritation and fatty degeneration of the liver. Experimentation with trichlorethylene has shown it to be available for industrial purposes in spite of its narcotic effect, as it has no such untoward effects as has trichlorethane on the vegetative organs. Giddiness or even unconsciousness has been observed, or, at times, a period of exaltation. These symptoms disappear quickly. The following conclusions are recorded: 1. In a comparatively small number of cases of trigeminal neuralgia or irritative neuritis the inhalation of trichlorethylene, continued for some time, appears to give excellent and lasting results. 2. In some cases, the period of relief after trichlorethylene may be interrupted by renewed attacks, which, as a rule, are of less violent character than before. 3. In most cases, it is a useful temporizing measure which, by diminishing the number and vehemence of the attacks, permits the patient's general as well as local condition to improve. 4. As the pain is only rarely uninfluenced by trichlorethylene, it should be tried in every case. 5. Furthermore, since trichlorethylene has no effect on facial neuralgias other than those of trigeminal origin, it may occasionally be of value in differential diagnosis.

Regional Anesthesia and Innervation of Teeth: Stewart and Wilson (*Edinburgh M. J.*, October, 1928) report on an investigation into the causes of the residual sensation found in the pulps of teeth after injection of the inferior dental nerve. Evidence is brought forward to show that this is due to the supply of the pulp fibers from the long buccal and lingual nerves, and that if they are effectively blocked the residual pain will disappear.—Abstr. *J. A. M. A.*

Self-Selection of Diet by Newly Weaned Infants: Continuing a study the preliminary report of which was published in THE JOURNAL (June, 1927), and covered observations on one child, Clara M. Davis (*Am. J. Dis. Child.*, October, 1928), reports observations on three newly weaned infants, two for periods of six months each and one for a period of a year. These babies were able from the first to select their own foods from a list of simple natural ones and in quantities sufficient to maintain themselves with apparently optimal digestive and good nutritional results as far as the immediate results could be judged. They were omnivorous and in eating were not only governed by their caloric needs, but also showed definite preferences, which changed from time and were not predictable. From the results obtained, the author concludes that: 1. The self-selected diet of simple, natural foods offers a safe means of dietary experimentation with breast-fed infants of weaning age. 2. Thus far, support is not given to the prevailing belief that the infant of this age cannot, because of his age, digest or use any of these simple natural foods of adult

life, or that glands or muscle cuts of meat which have been shown to be especially valuable proteins in the variety and combinations of their amino-acids should be excluded from their diet. 3. From the standpoint of digestion and as far as could be judged by the criteria mentioned, the diet selected by these infants was optimal, since in only one, and then only in the presence of an acute infection, was there any deviation from digestive conditions that at the present time are generally considered to be optimal. 4. From the standpoint of nutrition, conclusions as to the success of the self-selected diet for these infants are not warranted from a continuance of it for periods of only six months (two infants) and twelve months (one infant). The immediate results appear to be equal at least to the best results obtained by commonly prescribed diets in growth, weight, bone development, musculature, general vigor and appearance of health and well-being.

Electrosurgery: Elaborating on the dictum of Doyen, pioneer high frequency surgeon, that of all means employed in the destruction of pathologic tissue the only certain method is that of heat, E. N. Kime (*J. Indiana State M. J.*, November, 1928) reports his experience in about 500 cases of malignant and premalignant neoplasms and infectious granulomas seen within the past five years in private and hospital practice. He concludes that: 1. The cure of such lesions demands either destruction *in situ* or extirpation *in toto*. 2. The ideal technic, skillfully applied, accomplishes both at the primary operation when either one or more of the following electrothermic methods are correctly employed: electrodessication, electrocoagulation and electrothermic excision. If superficial destruction is all that is necessary, such as in premalignant neoplasms of all kinds and in most any location: verrucae, nevi, lupus vulgaris, lupus erythematosis, tuberculous sinuses, furuncle, rodent ulcer, leukoplakia and superficial infections of the skin, chancroidal ulcers, cervical erosions, urethral carbuncle and a host of other lesions which are occasionally resistant to the usual medicinal and surgical regimen, electrodessication is often applicable. This is especially true in regions where, for some reason, scar tissue is to be avoided at all costs. If, on the other hand, the lesion is more fungating, of more hyperplastic type, and where scar tissue formation is of secondary importance, electrocoagulation with or without excision is preferable. Unless excision is feasible, the author's practice is first to coagulate thoroughly around and beneath the lesion, curet away all necrotic material and then coagulate again one or more times until satisfied that all the diseased tissue has been removed. This practice is more radical than that often advised, and sometimes necessitates ligation of large vessels, and the severance of ducts or nerves, but in the presence of cancer such a course is obligatory. If the malignancy is destroyed and removed, the wounds usually heal with surprisingly little scar. If the use of skin grafts is necessary, they usually "take" well. In stimulation of wound healing, in combating infection and keloid, the water-cooled quartz light has been very valuable. It is even possible to excise electrothermically a small keloid and prevent its reformation by the use of pressure radiation of the granulations through a quartz prism. Electrocoagulation is the agency of choice in accessible malignancy, large condylomata and carbuncle. The author has used it in cancer of the nose, ear, eyelid, vulva, cervix, breast, lip, cheek and extremities. His results in a series of 100 cases, followed from one to three years, were as follows: two deaths in cases already having general metastases, and nine recurrences, in five of which subsequent operation has been attended with apparent success.

Relationship Between Dental and Ocular Lesions: There are two ways in which the ophthalmic surgeon can give assistance to the dental surgeon. The first is by noting certain slight ocular changes which in his experience are suggestive of focal sepsis and determining as far as he can if the focus is dental, tonsillar or intestinal. If there is evidence that the teeth may be the cause because they are obviously carious or heavily filled or crowned, or because there is obvious gingivitis, he may send the patient with a letter explaining the importance of the ocular signs to the patient's own dentist. In some cases in which he is particularly interested, he will probably have had dental radiographs taken by a radiologist, on which he will ask the dental surgeon to give his opinion in conjunction with his clinical examination of the patient's teeth. In all cases, the dental radiographs should be of

all the teeth and of edentulous areas. If the patient is under general medical treatment at the time, it is important that his medical adviser be informed of the dental surgeon's opinion on the case, as well as of the ocular findings. The second mode of assistance which can be given by the ophthalmic surgeon is when he is consulted by a dental surgeon as to the advisability of retaining in the jaws a tooth or teeth concerning which the dentist is not sure, or which the patient is anxious to retain, contrary to dental advice. It is well known that in many cases a barrier to the absorption of toxic products from a septic tooth is successfully raised; in other words, the patient's resistance is good. In such cases, ocular signs are absent, except for permanent changes which may have been produced by other preexisting toxic causes. When the patient's resistance to the absorption of toxic products from a septic tooth begins to break down, changes almost inevitably occur in the eye. One or more of these ocular sigas may appear. The earliest sign in my experience is a condition of hyperemia of the retina in the macular region. This is very soon replaced by slight degenerative changes, though the visual acuity may remain good. There is no doubt that the eye is an extraordinarily sensitive danger signal in the presence of any form ot chronic sepsis in the body. It reacts in a similar manner to all forms of sepsis, though apparently more quickly in dental and tonsillar sepsis than in other forms. In a case in which important changes are occurring in a patient's eye, and in which there is dental sepsis present, it is clear that the mouth must be rendered as clean as possible as quickly as possible.—A. F. MacCallan, in *Dent. Surgeon,* Oct. 13, 1928.

Preparation of Patient for Anesthesia: About the first thing to be done in the preparation of the patient is the proper prophylaxis of the mouth. The average hospital does not pay enough attention to this important feature. Infected tonsils should first be removed. This should be done before the main operation, and not with it. Complicated and unnecessarily prolonged operations are not to the best interest of the patient. Decayed teeth should be removed, filled or treated as the case may be, to rid the patient of this focal infection. It improves the general health and, by placing the mouth in a less septic condition, makes the convalescence less liable for dental and perhaps pulmonary complications. Heavily furred tongue and foul breath should indicate special attention to the digestive tract. Whether the false teeth should be removed before the operation is always a question for the anesthetist to decide. Small loose bridgework should always be removed, but large plates are sometimes best left *in situ,* as they keep the face filled out and thus prevent the escape of anesthetic gases. When it is necessary to remove them, a suitable airway is a great aid in keeping the respiratory tract free. When examining the mouth, the anesthetist should observe the best location for a mouth gag, should its later introduction become necessary.—Charles J. Wells, in *Cur. Res. Anes. Anal.,* September-October, 1928.

Angiosarcoma of Tongue: Freeman *(Colorado Med.)* reports a case of angiosarcoma of the tongue in a boy, aged 5. It had originated some two years previously, deep in the tissues of the middle third of the right side of the organ, and had gradually enlarged until it occupied almost the entire mouth, rendering swallowing difficult and articulation impossible. Its size approached that of a large walnut or golf ball. At one point on its superior surface was an excrescence as large as the end of a finger, and at another point an unhealthy ulceration, which added much to the patient's inconvenience. He was obliged to hold his mouth partly open and saliva drooled from it more or less constantly. There were many enlarged cervical lymph nodes, especially in the submaxillary regions. In view of the appearance of the growth, the enlargement of the cervical glands and the cachectic look of the patient, a tentative diagnosis of sarcoma was made. The problem was to remove this large, vascular, nonpedunculated mass without undue hemorrhage. This was accomplished with the help of two long mattress needles. One of these was weaved in and out of the mucosa superficially across the top of the base of the tongue, while the other was similarly applied below, so as to grasp the organ between them. The ends of the needles, which projected from the corners of the mouth, were then bound together with ordinary rubber bands, one on each side, thus firmly compressing the intervening tissues and controlling the circulation. After the tourniquet was adjusted, the remainder of the operation was comparatively easy. The tumor, which was largely, but not completely,

encapsulated, was partly enucleated and partly cut from its surroundings leaving a large irregular defect on the right side and extending well over to the left. Fortunately, the tongue was rather large, so that by careful stitching with chromic gut it was reconstructed into some sort of resemblance to the normal. No attempt was made to remove the large glandular masses from the neck, and the hypertrophied tonsils were not interfered with. When the boy left the hospital, at the end of about two weeks, he was in reasonably good condition, outside of a swollen neck and tongue, which was somewhat uneven in contour and not entirely healed. The pathologic report was angiosarcoma. A little over a year after the operation, the boy was not only alive but in excellent condition. The tongue, although badly scarred and somewhat deformed, was equal to all his requirements, and he could talk fluently. The glandular swellings in the neck had disappeared, except for some small nodes in the submaxillary regions, which could be accounted for by the enlarged tonsils. No recurrence of the tumor could be detected anywhere.—Abstr. *J. A. M. A.*

Foci of Infection in Infectious Arthritis: In 119 cases analyzed by Bockoven *(U. S. Veterans' Bur. M. Bull.)*, one focus of infection was found in sixty; two foci in forty; more than two foci in twenty-one, and no foci in eighteen. Pyorrhea was present in fifty-five cases, dental abscess in forty-six, gingivitis in thirty-five, tonsillitis in twenty-six, prostatitis in twelve, constipation in eight, appendicitis in six, and cholecystitis in five. Sinusitis, infected adenoid tissue, colitis and extensive dermatitis were found in four cases.—Abstr. *J. A. M. A.*

Foreign Literature

Mistakes in Orthodontia (Emil Herbst, Fortschr. d. Zahnheilk., No. 10, 1928, p. 855): For a thorough comprehension of the characteristics and abnormalities of the dentition, the author believes a knowledge of the ontology is essential. The development of the dental lamina is not dependent on other embryonic processes. Growth and developmental disturbances of the jaws have nothing to do with the products of the dental lamina. Maldeveloped jaw bones are found with normal teeth, and well-developed jaws with abnormally developed teeth. Maldevelopment of both may occur simultaneously. They are, however, absolutely independent of each other. . . . Anomalous tooth positions are often merely symptoms of maldeveloped jaws. . . . In a chapter on orthognathic therapy, the author devotes about twenty pages to a thorough discussion of the mistakes in orthodontic treatment. This is dealt with in the light of the ontologic conception . . . . With all the possible errors in mind, the author concludes that extraction for orthodontic correction should be resorted to only on thorough consideration of the following: 1. Drifting of teeth that is undesirable should be prevented after extraction. 2. Upper cuspids should be sacrificed only as a last resort. Since these teeth carry the facial muscles, their retention is essential to normal facial expression. 3. In the event bicuspids are to be removed, the second bicuspids should be sacrificed if this is at all possible. 4. In the event of nasal obstruction, extraction should be avoided. 5. Extraction of first molars with the view to obtaining distal movement of all teeth except the molars will result in disappointment, since growth of the jaws takes place from the anterior to the posterior aspect. 6. If there is no need for space and if no bite irregularities exist, extraction is permissible only if too many teeth are present. 7. If there is a difference in the number of teeth in the jaws, and Nature has not provided for this difference, extraction should be considered. 8. In case of extreme prognathism, extraction of the lower first bicuspids may be regarded as a palliative measure. 9. Unilateral lingually erupted upper second bicuspids may, in many cases, be extracted. 10. If there are too many teeth, the second bicuspids may be extracted for esthetic reasons. 11. In rachitic jaws, extraction of the four first molars is frequently indicated. 12. In the case of supernumerary teeth, extraction is indicated. 13. The presence of a pathologic condition may make extraction unavoidable. 14. In older people, when irregularities of the permanent teeth exist, extraction may be necessary. 15. Maldeveloped teeth, fused teeth, etc., may be extracted. 16. Maldevelopment of the jaws may make extraction desirable.

Emil Mueller, Chicago.

Denture Prosthesis (Paul Wustrow, Fortschr. d. Zahnheilk., No. 10, 1928, p. 931): In a 36-page article, the author reviews the progress made during the year in denture prosthesis. He deals with the subject under the following headings: impression taking, ar-

ticulation, articulators, condyle path registration, bite taking and clasping. Under articulation, he shows that the condyle can move away from the fossa and path in a vertical direction in any position of jaw movement. The appliances used for determining this movement are illustrated and the method used is described. The chapter on articulators offers a detailed discussion of the various types of articulators in use. All are illustrated. The author finds little use for articulators with average registrations. He believes in the use of anatomic articulators only. The anatomic articulators of Gysi and of Schröder-Rumpel are extensively dealt with. The descriptions of the methods used with the two appliances is accompanied with many illustrations. An extensive bibliography is appended to this very fine article.

EMIL MUELLER, Chicago.

Dental Materials (Eugen Wannanmacher, Fortschr. d. Zahnheilk., No. 10, 1928, p. 913): This chapter is divided into three subheads: impression material, denture materials and silicate materials. Under impression materials, the author considers the work of Deichmann on the expansion of plaster of greatest importance. For the control of expansion of plaster, the following proportions are recommended: water, six parts, plaster, ten parts. The incorporation of prepared chalk into the plaster also tends to reduce its expansion properties. The use of water at 40 C. also lessens the expansion. A 2 per cent solution of potassium sulphate and a 6 per cent solution of sodium chlorid also are used for the same purposes. A most promising impression material used in Europe for about a year is just now being introduced in this country. This material differs from all other impression materials in that it is elastic and copies all undercuts faithfully. The silicate cements are treated from all angles. Many of the silicate cements were tested for edge strength, crushing strength, heat generation tests in mixing and setting and behavior in acids, alkalis and water.

EMIL MUELLER, Chicago.

Systematic Examination Regarding the Width of the Periodontal Space (A. Klein, Zeitschr. f. Stomatol., Vol. 4, 1928, p. 417): Microscopic measurements have been made to determine the thickness of the periodontal membrane at different portions of the root and at different ages. The results are: The average width of the periodontal membrane is 0.25 mm. At the alveolar margin, the membrane is wider (average, 0.39 mm.), narrower at the middle of the root (0.17 mm.), and again wider at the apical portion (0.21 mm). The narrowest point in the periodontal membrane is a little below the middle of the alveolus. In older individuals, the periodontal membrane becomes somewhat wider, with an average increase of one-sixth the width in younger individuals.

BALINT ORBAN, Chicago.

Disinfecting Action of Highly Concentrated Iodin Solutions (A. Grabner, Zeithscher. f. Stomatol., Vol. 2, 1928, p. 159): The author compares the action of different concentrations of iodin solutions on vegetative bacteria and spores, using from 5 to 25 per cent alcoholic solutions and from 15 to 25 per cent aqueous solutions. The higher concentrations have shown a much more rapid and more nearly perfect result than lower concentrations. The best action was obtained by the 25 per cent aqueous solution. All in all, the aqueous solutions have shown a more favorable reaction than the corresponding alcoholic solutions. He has found that, in a physiologic sodium chlorid solution, low concentrations of iodin are strongly disinfectant.

BALINT ORBAN, Chicago.

Teeth in Dermoid Cysts of the Ovaries (Dr. Kanamori, Vierteljahrschr. f. Zahnheilk., 44, No. 3, 1928): In the second and concluding part of the article, the first part of which was reviewed in the November, 1928, issue of THE JOURNAL, Dr. Kanamori presents his histologic findings, some photographs of his slides and a summary of his studies of this subject, which includes also a detailed review of the writings of other men that he has been able to find in the literature. He mentions the fact that nobody could find caries in teeth of dermoid cysts, which is conceivable, because these teeth are not exposed, but are inclosed in the cyst. Typical periodontal membrane Kanamori fails to find, but in its stead a conglomeration of bone, connective tissue, fat and hair approximates the teeth, homologous with the tumor mass itself. In the dentin and cementum, he found evidence of resorption and new building. In the enamel, he shows bone completely imbedded in the enamel. Outside of and next to the enamel, he found, in many cases, cystic cavities filled with partly calcified cyst fluid.

JAMES D. FRANKEL, Chicago.

MISCELLANY

BOOK REVIEWS

The Technic of Oral Radiography. By Clarence O. Simpson, M.D., D.D.S., F.A.C.D., Professor of Radiodontia in the Washington University School of Dentistry, St. Louis, Mo. 165 illustrations; second edition, 207 pages, price $5.00. Published by The C. V. Mosby Company, St. Louis, Mo.

If there is one thing emphasized in this book it is the necessity for definiteness in detail. In the preface to the second edition, the author raises the question as to why certain definite positions should not be taken by the patient and by the film packet when it is apparent that some position must be taken. This is the keynote of the book, and no dentist will get the most out of the volume unless he follows the author's instructions. It may be taken for granted that Dr. Simpson does not make recommendations without a very excellent reason, and in view of the explicitness of his descriptions, the reader would do well to observe them. There is a clearness to Dr. Simpson's style that leaves no room for doubt as to his meaning, and this is of especial value in describing technical processes in any department of our work. Therefore, this book is a most satisfactory one, whether for the beginner in the work or for the practitioner of experience. A notable feature of the book is the unusually excellent quality of the paper used, which always lends itself to the most satisfactory results in the illustrations. The book should have a place in every dental library.

A Textbook of Physiology. By William D. Zoethout, Ph.D., Professor of Physiology in the Chicago College of Dental Surgery (Loyola University) and in the Chicago Normal School of Physical Education. Third edition, 664 pages, price $4.50. Published by The C. V. Mosby Company, St. Louis, Mo.

When the first edition of this book was issued, it enjoyed a very favorable reception on the part of the profession. Professor Zoethout has studied and taught physiology so long that he is thoroughly familiar with the subject, and a book from him is well worthy of consideration.

Probably the chapter on "Digestion" will prove of the greatest interest to the dentist, taking up, as it does, though in brief form, the consideration of the teeth in the process of mastication, the saliva and the various organs concerned in the process of digestion. The author has the faculty of going directly to his subject, and not wasting words in his descriptions.

If physiology may be called "the romance of the medical sciences," Dr. Zoethout's book may well be entitled to a place of prominence among the interesting contributions to our professional literature.

NEWS

Dental Service of Florida State Hospital: The Florida State Hospital, the only institution in the state for the care of the indigent insane, and caring for more than 3,000 patients, has had a dental service for some time, but it was in 1926 that the inadequacy of the service became so evident that a second dentist was employed and two dental assistants and a laboratory technician were added to the staff. The dental infirmary now consists of three complete operating rooms, laboratory, sterilizing facilities, and business quarters. Most of the furnishings were made in the institution, at a great saving of expense. Admissions to the clinic are increasing at the rate of 1,000 per year.

Dr. Giffen Honored: William A. Giffen, of Detroit, Mich., was honored at a dinner given by the First District Dental Society, November 15. P. J. O'Reilly acted as toastmaster. Dr. Giffen was presented with a golf outfit.

Dental Treatment for Pribilof Islanders: The offer of providing dental treatment for the white and native population of the Pribilof Islands has been accepted by the dean of the University of California Dental College. The Pribilof Islands are seven steamer days north of Seattle in summer

and are icebound in winter. The inhabitants are engaged chiefly in hunting seals. The Indians have not received dental treatment in any form since 1926. Plans are being made to send to the islands H. C. Meade, D.D.S., a 1928 graduate. Only about twenty white people winter in the islands, the remainder of the inhabitants being Indians. They live comfortably in winter. Their quarters are well built, food is ample, radio reception is excellent and motion picture entertainments are given once a week.—*J. A. M. A.*

Dr. Irwin Honored: Alphonso Irwin, Camden, N. J., founder of the Camden Free Dental Clinic, was recently tendered a testimonial dinner by the Southern Dental Society, of which he was an organizer in 1900. Dr. Irwin has four times been elected to represent New Jersey at international dental congresses. As compiler of "Dental License Requirements Throughout the World," he answers 1,000 queries yearly.

An Honor to the Dental Profession: Our distinguished colleague Dr. Florestan Aguilar of Madrid, Spain—President of the International Dental Federation—has just had a unique honor conferred on him by his Government. He has been made a count —the first time such a distinction has been accorded a dentist. Our heartiest congratulations to Count Aguilar, and may he live long to enjoy his honors.

Death of Dr. Harry P. Carlton: As we go to press word comes of the death on November 21, 1928, after an illness of several months, of Dr. Harry P. Carlton, of Oakland, California. He was 66 years of age, and had enjoyed all of the honors in the gift of his State, where he was universally beloved.

Death of Dr. Maximow: Alexander A. Maximow, professor of anatomy at the University of Chicago School of Medicine since 1922, and world renowned histologist, died suddenly, December 4, at the age of 52. Dr. Maximow with his wife and sister, escaped from Soviet Russia during the World War.

Deaths

Beguian, Parnag, Chicago, Ill.; Chicago College of Dental Surgery, Dental Department of Loyola University, 1917; died, November 2, of nephritis; aged 38. The widow and one daughter survive.

Chester, William E., Norwood, Ohio; Ohio College of Dental Surgery, Dental Department of the University of Cincinnati, 1903; died recently.

Crovatt, Thayer R., Thomasville, Ga.; Southern Dental College, 1906; died, October 21, while playing golf; aged 47. He is survived by his wife and two daughters.

Emminger, A. F., Los Angeles, Calif.; Ohio College of Dental Surgery, Dental Department of the University of Cincinnati, 1876; died, July 29; aged 81. Dr. Emminger practiced in Columbus, Ohio, for fifty years. He was a past president of the Ohio State Dental Society and of the state board of Dental examiners. He retired from active practice in 1917.

Kirby, Karl H., Richmond, Va.; School of Dentistry of the Medical College of Virginia, 1923; was killed in an automobile accident, September 24; aged 33.

Sprinkel, George A., Jr., Richmond, Va.; University of Maryland School of Dentistry, 1898; died, September 21; aged 54.

Sullivan, John Clement, Little Falls, N. Y.; Temple University School of Dentistry, 1893; died, November 16; aged 72. Dr. Sullivan was in active practice up to the day of his death. He had always taken a great interest in the activities of the national and local dental societies. His wife, and one son, Edmund, who was in practice with his father, and a daughter survive.

Tremper, William D., Portsmouth, Ohio; Ohio College of Dental Surgery, Dental Department of the University of Cincinnati, 1870; died, November 9.

ANNOUNCEMENTS

CALENDAR OF MEETINGS*

NATIONAL SOCIETIES

American Dental Association, Washington, D. C., Oct. 7-11, 1929.

American Society of Orthodontists, Estes Park, Colo., July 15-19, 1929.

STATE SOCIETIES

District of Columbia, at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June inclusive.

March (1929)

Minnesota, at St. Paul (6-8).
Montana, at Butte (28-30).

April (1929)

Alabama, at Birmingham (16-18).
Connecticut, at Waterbury (April 30-May 2).
Kansas, at Wichita (April 29-May 2).
Kentucky, at Louisville (9-11).
Mississippi, at Jackson (22-24).
New Jersey, at Asbury Park (10-13).
Texas, at Beaumont (16-19).
Virginia, at Danville (April 30-May 2).

May (1929)

Arkansas, at Little Rock (20-22).
Illinois, at Springfield (14-16).
Indiana, at Indianapolis (20-22).
Iowa, at Cedar Rapids (7-9).
Maryland, at Baltimore (6-8).
Massachusetts, at Boston (6-10).
Missouri, at St. Joseph (12-14).
Nebraska, at Omaha (20-23).
New York, at Rochester (15-17).
North Dakota, at Grand Forks (14-16).
Southern California, at Los Angeles (6-7).
Vermont, at Burlington (22-24).
West Virginia, at White Sulphur Springs (27-29).

June (1929)

Georgia, at Atlanta (12-14).
Maine, at South Poland (20-22).
Nevada, at Reno (1).

July (1929)

California, at San Francisco (8-12).
Colorado, at Colorado Springs (17-19).
Oregon, at San Francisco (8-12).
South Dakota, at Rapid City (1-2).
Utah, at San Francisco (8-12).
Washington, at San Francisco (8-12).
Wisconsin, at Milwaukee (9-11).

*Announcements must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

Baltimore City Dental Society, Fourth Annual Midwinter Clinic, Feb. 1-2, 1929.

Chicago Dental Society Midwinter Clinic, Jan. 14-16, 1929.

Dallas Midwinter Clinic, Feb. 11-13, 1929.

Southern Society of Orthodontists, Macon, Ga., Jan. 31-Feb. 2, 1929.

Southwestern Society of Orthodontists, Dallas, Texas, Jan. 2-5, 1929.

MEETINGS OF STATE BOARDS OF DENTAL EXAMINERS

Delaware, at Wilmington, Jan. 16-17, 1929. W. S. P. Combs, Secretary, Middletown.

Minnesota, at Minneapolis, Jan. 11, 1929. F. E. Cobb, Secretary, 601 Donaldson Bldg., Minneapolis.

North Carolina, at Raleigh, Jan. 8, 1929. H. L. Keith, Secretary, 409 Murchison Bldg., Wilmington.

North Dakota, at Grand Forks, Jan. 8-11, 1929. Gilbert Moskau, Secretary, Grand Forks.

Oklahoma, at Oklahoma City, Jan. 7, 1929. Charles A. Hess, Secretary, Idabel.

South Dakota, at Sioux Falls, Jan. 7, 1929. Secretary, G. G. Campbell, Mitchell.

AMERICAN DENTAL ASSOCIATION

The Seventy-First Annual Session of the American Dental Association will be held in Washington, D. C., Oct. 7-11, 1929.

UNIVERSITY OF BUFFALO SCHOOL OF DENTISTRY ALUMNI ASSOCIATION

The twenty-ninth annual meeting of the University of Buffalo School of Dentistry

Alumni Association will be held in Buffalo at the Hotel Statler, Wednesday-Friday, February 27-March 1.

L. J. GAUCHAT, *Chairman of Publicity.*

NORTH CAROLINA STATE BOARD OF DENTAL EXAMINERS

The next regular meeting of the North Carolina State Board of Dental Examiners will be held in Raleigh, beginning promptly at 9 a. m., Monday, January 7. For further information and application blanks, address

H. L. KEITH, *Secretary,*
409 Murchison Bldg.,
Wilmington.

ARKANSAS STATE DENTAL SOCIETY

The Arkansas State Dental Society will hold its annual meeting at the Marion Hotel, Little Rock, May 20-22.

I. M. STERNBERG, *Sec'y-Treas.,*
Fort Smith.

DALLAS MID-WINTER DENTAL CLINIC

In addition to the clinicians already announced for the Dallas Mid-Winter Dental Clinic, to be held February 11-13, Oren A. Oliver, Nashville, Tenn., will present a clinic on orthodontia. Clinicians previously announced are T. W. Maves, Cleveland, Ohio, oral surgery; J. W. Crawford, Milwaukee, prosthetics, and Menifee R. Howard, Denver, Colo., surgery.

MISSISSIPPI DENTAL ASSOCIATION

The fifty-fourth annual session of the Mississipi Dental Association will be held in Jackson, April 22-24. C. K. Bailey, Grenada, is president and C. A. Moore, Lexington, secretary.

E. A. MAY, *Executive Committeeman,*
Jackson.

AMERICAN SOCIETY OF ORTHODONTISTS

The annual meeting of the American Society of Orthodontists will be held in Estes Park, Colo., from Monday evening, July 15, to Friday afternoon, July 19. The hotels are the Stanley (headquarters), Crags, Lewiston and Elkhorn Lodge. All ethical dentists are invited. A registration fee of $10 will be charged non-members. For hotel information, write Fred W. Beesley, Republic Bldg., Denver, Colo. Regarding transportation, write Kirman E. Taylor, Mack Bldg., Denver.

ALBERT H. KETCHAM, *President,*
CHARLES R. BAKER, *Secretary,*
708 Church St.,
Evanston, Ill.

BALTIMORE CITY DENTAL SOCIETY FOURTH ANNUAL MIDWINTER CLINIC

The next annual Midwinter Clinic to be sponsored by the Baltimore City Dental Society will be held, Friday and Saturday, February 1 and 2. Paul R. Stillman, New York City, will give a clinic on "The Problem of Prevention of Dental and Periodontal Disease"; William E. Harper, Chicago, on "The Fundamental Factors Involved in Making Amalgam and the Operative Procedure Necessary to Make Permanently Strong, Non-Leaking Fillings," and Edward Kennedy, New York City, on "Partial Dentures." Emory C. Thompson, Buffalo, will also be on the program and will present a clinic on fixed bridgework, inlays or some new types of fixed bridge attachments.

The number subscribing to the clinic is limited to 200 and the fee is $15. Applications are accepted in the order in which they are received until the list is closed. Checks should be made payable to F. Noel Smith, treasurer, and mailed to George B. Jersin, chairman of the clinic membership committee, 317 Medical Arts Building, Baltimore, Md.

JAMES H. FERGUSON, JR., *Chairman,*
Midwinter Clinic,
Medical Arts Building,
Baltimore.

SOUTHERN SOCIETY OF ORTHODONTISTS

The eighth annual session of the Southern Society of Orthodontists will be held in Macon, Ga., January 31-February 2. A cordial invitation is extended to all ethical members of the dental and medical professions to attend.

W. B. CHILDS, *President,*
Casualty Bldg.,
Macon, Ga.

OREN A. OLIVER, *Secretary,*
1101 Medical Arts Bldg.,
Nashville, Tenn.

CHICAGO DENTAL SOCIETY SIXTY-FIFTH ANNUAL MEETING AND CLINIC

January 14-16, 1929

STEVENS HOTEL

The Chicago Dental Society wishes to announce the 1929 Annual Meeting and Clinic at the Stevens Hotel. Please take notice of change from the Drake Hotel to the Stevens Hotel with its 3,000 rooms ranging from $4.00 upwards, with ideal conditions for staging the yearly classic.

All members of the American Dental Association are cordially invited to attend. Preliminary programs will be mailed to all members of the A. D. A. The program will be divided into eight sections as follows:

Section I—Operative Dentistry
Chairman: O. J. Olafsson, 55 E. Washington St.
Secretary: E. J. Krejci, 7060 Clyde Ave.

Section II—Full Dentures
Chairman: R. O. Schlosser, Northwestern University.
Secretary: E. C. Pendleton, Chicago College of Dental Surgery.

Section III—Partial Dentures; Crown and Bridge
Chairman: Stanley D. Tylman, 185 N. Wabash Ave.
Secretary: W. H. Kubacki, 2949 Milwaukee Ave.

Section IV—Mouth Hygiene, Children's Dentistry
Chairman: E. E. Graham, 58 E. Washington St.
Secretary: E. W. Swanson, 25 E. Washington St.

Section V—Orthodontia
Chairman: B. O. Sippy, 30 N. Michigan Ave.
Secretary: C. R. Baker, 708 Church St., Evanston.

Section VI—Oral Pathology
Chairman: E. H. Hatton, Northwestern University.
Secretary: J. R. Blayney, University of Illinois.

Section VII—Oral Surgery
Chairman: J. E. Schaefer, 55 E. Washington St.
Secretary: Eli Olech, 4259 W. Madison St.

Section VIII—Radiology
Chairman: E. H. Thomas, 30 N. Michigan Ave.
Secretary: M. A. Root, Jr., 636 Church St., Evanston.

The Program Committee is under the direction of Frederick B. Noyes, assisted by Stanley D. Tylman, vice-chairman, I. G. Jirka, Charles R. Baker and Howard Alexander.

Louis E. Jelinek, *President*
Hugo G. Fisher, *Secretary*
185 N. Wabash Ave.

PATENTS OF INTEREST TO DENTISTS

1533123. Tongle-cleaning device, Oscar L. Lewis, St. Louis, Mo.

1534592. Dental oven, Henry C. Houck, Seattle, Wash.

1534802. Lower artificial denture, Fred E. Milner, Blackpool, England.

1534657. Rotary toothbrush, Charles S. Patterson, Lancaster, Calif.

1534816. Dental tool holder, W. L. Thiedmann, Muskegon, Mich.

1534817. Dental tool, W. L. Thiedmann and H. M. Hardy, Muskegon, Mich.

1535187. Dental handpiece, Walter J. Terry, Seattle, Wash.

1535359. X-ray filter or screen, Sinclair Tousey, New York City.

1536079. Dental burner, Ernest E. Dalton, Chicago, Ill.

1536341. Dental x-ray film package, Millard B. Hodgson, Rochester, N. Y.

1536345. Dental x-ray film package, John G. Jones and H. G. Dewey, Rochester, N. Y.

1536305. Dentifrice material, Ferdinand W. Nitardy, Brooklyn, N. Y.

1537793. Dental tweezers, T. F. Bates, Shelbyville, Tenn.

1537925. Dental x-ray package, Leonard M. Bolin, Chicago, Ill.

1537811. Hand guard and deciduous tooth erupters, Giles T. Epling, Welch, W. Va.

1537467. Folding toothbrush, Arthur G. Ingle, Portland, Ore.

1537853. Tooth-cleaning device, Saul Mason, Detroit, Mich.

1537253. Container for dental floss. G. F. Miller, Brooklyn, N. Y.

1537884. Clamp for dental flasks, W. M. Romine and W. J. Clark, Wichita, Kan.

American Dental Association

Scientific Foundation and Research Commission

INFORMATION TO BE SUPPLIED IN CONNECTION WITH APPLICATION FOR GRANT

The following data are required with each application for a grant, in order that full information may be in the hands of the Commission.

All applications, typewritten in triplicate, that are in the hands of the Secretary of the Commission *on or before December 15*, of any year will come up for final action at the annual meeting of the Scientific Foundation and Research Commission at the time of the annual meeting of the American Dental Association in the year following. Applications received at any other time will be held over until the following December, and then be considered in regular course.

Each of the following headings should be listed as exhibits. Each calls for a different type of information. A separate sheet, or any number of sheets, of paper should be used for each exhibit, and the first sheet for each exhibit should be marked at the top with exhibit letter, the heading of the particular exhibit, the title of the problem and your name. Please use letter size paper, (8½x11 inches), and leave 2 inches blank at the top of every sheet.

Exhibit A. Historical Review: Give list of important articles on the subject, with authors and publication references, also brief outline or summary for each. This should be sufficiently complete to give a good understanding of the background for the problem.

Exhibit B. Present Status: Give your opinion of the present status of this problem. This may be the net result of all previous work on this problem, and the reasons prompting you to undertake it.

Exhibit C. Proposed Work and Estimate of Funds Required: State what you wish to do, your plan of procedure, estimate of funds required and whether a part of the amount may be available from other sources. This should be in sufficient detail to give the commission a good understanding of your plans.

Exhibit D. Facilities: State what facilities are at your command for the prosecution of this work, where it will be done, and the space and equipment available.

Exhibit E. Personnel: State how much of your time you propose to devote to this problem, and what assistance you will have, if any, in the way of consultants, technicians, advisors, etc.

Exhibit F. Qualifications of Personnel: For yourself and each person, if others beside yourself are to be engaged with this problem, prepare a separate statement marked Exhibit F for yourself, and Exhibit F1, Exhibit F2, etc. for others, giving the following information: (a) age; (b) degree from college of arts with year; or the number of years you attended, name of college and dates; (c) other degrees with names of schools and years (dental, medical, advanced degrees); (d) teaching experience; (f) list of papers on this or related subjects, with publication references; (g) previous work in research.

EXTENSION OF TIME FOR RECEIVING APPLICATIONS

As it has been impossible to have our new requirements published in THE JOURNAL earlier than in the January issue, it is deemed advisable to extend the time for receiving these applications to February 15, 1929. This modification applies only to this year. Application blanks can be secured by addressing the Secretary, Homer C. Brown, 609 Hartman Building, Columbus, Ohio.